National Research Council Canada
Associate Committee on Hydrology

Conseil national de recherches Canada
Comité associé sur l'hydrologie

ÉVÉNEMENTS HYDROLOGIQUES
ÉDITION SPÉCIALE

HYDROLOGICAL EVENTS
SPECIAL EDITION

BIBLIOGRAPHIE 1984 BIBLIOGRAPHY

PRÉPARÉE PAR **PRODUCED BY**

WATDOC

Direction générale des eaux intérieures
Environnement Canada

Inland Waters Directorate
Environment Canada

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INTRODUCTION

The 1984 Bibliography is published by the Associate Committee on Hydrology (ACH) as a special edition of this newsletter to foster communication in the field of hydrology in Canada. It was produced by WATDOC directly from its online databases, Canadian Environment and Environnement, in collaboration with the ACH Secretariat.

WATDOC searched the databases for relevant references added from July 1983 to August 1984 and organized them according to subject terms and guidelines provided by the Secretariat. Because of technical complications, it was impossible to produce the text with French accents.

Information about the availability of documents cited in the Bibliography can be obtained from the complete online database references. The user may search the databases or arrange for access through a library service.

WATDOC welcomes contributions of hydrological publications, as well as other water-related literature, for referencing in the databases. For further information, contact the Manager, WATDOC, Inland Waters Directorate, Ottawa, Ontario, K1A 0E7. Telephone (819) 997-2324 or 997-1238.

INTRODUCTION

La Bibliographie 1984 publiée par le Comité associé sur l'hydrologie (CAH), est une édition spéciale du présent bulletin et a pour but d'encourager la communication dans le domaine de l'hydrologie au Canada. En collaboration avec le Secrétariat du CAH, le WATDOC a dirigé sa compilation en prélevant l'information de ses bases de données Canadian Environment et Environnement.

Après consultation de ses bases de données, le WATDOC a prélevé les références pertinentes, répertoriées de juillet 1983 à août 1984, et les a classées en fonction des sujets et des lignes directrices fournis par le Secrétariat. En raison de complications techniques, il a été impossible d'inclure les accents français dans le texte.

L'utilisateur peut se renseigner sur la disponibilité des documents cités dans la Bibliographie à la lecture des références bibliographiques complètes contenues dans les bases de données. Il peut consulter ces dernières en direct ou par l'intermédiaire des services d'une bibliothèque.

Le WATDOC accepte avec plaisir les publications concernant l'hydrologie ainsi que toute autre documentation sur les ressources en eau en vue de leur répertoriage. Pour obtenir de plus amples renseignements à ce sujet, veuillez communiquer avec le chef, WATDOC, Direction générale des eaux intérieures, Ottawa (Ontario) K1A 0E7. Téléphone (819) 997-2324 ou 997-1238.

1. RESOURCE MANAGEMENT - AMENAGEMENT DES RESSOURCES

066609
Environmental Challenges: 1983, A conference on major environmental issues, At the Hamilton Convention Centre, Chedoke Hall, October 27-29, 1983 * 103p * Environ Can * (1983).

This conference was sponsored by Environment Canada as part of the Department's policy on public consultation and information availability as a means of attaining public input into the development of national policies and programs. The keynote address was delivered by the Honorable C. Caccia. Presentations made at the conference dealt with the following issues: acid rain, chemical wastes, land use, energy production, and the water quality of Lake Ontario. Several environmental issues of general concern were discussed and a review was presented of the 1982 Public Consultation Program. Recommendations stemming from seminars on the following topics are presented: chemical wastes - the question of disposal; land use - identifying priorities; acid rain: the North American dilemma; energy production - future prospectives; Lake Ontario - water quality; environmental management - the ecosystem approach; environmental law and remedies; public consultation - the state of the art in Ontario; and the role of the government - it's responsibilities and limits.

F11367
AFF INDIENNES ET DU NORD CAN * **La mise en valeur des ressources naturelles du Nord: exigences, procedures et legislation** * 31p * Aff indiennes et du Nord Can * 1981-12.

Ce document vise a determiner les diverses autorisations requises, a preciser les differentes lois et methodes reliees a l'exploitation des ressources naturelles du Nord. On presente une description des processus d'examen que comprend la mise en valeur des ressources naturelles dans le Nord et on explique les types d'autorisations requises et les methodes prevues pour soumettre une demande, ainsi que les divers organismes interesses. Les lois et reglements administres par le ministere des Affaires indiennes et du Nord canadien, sont brievement decrits.

066623
ALBERTA ENVIRON, RES MANAGE DIV * **Research Management Division annual report for the fiscal year 1982/83** * RMD Rep 83/22 * 52p * Alberta Environ, Res Manage Div, Edmonton, Alta * 1983-08.

063699
BARKER ML, SEWELL WRD * **Water problems and policies: Canadian experience in an international context, Chapter 1** . IN: Water problems and policies * SEWELL WRD, BARKER ML * Cornett Occas Pap No 1 * 1-4 * Dep Geogr, Univ Victoria, Victoria, BC V8W 2Y2 * 1980.

A brief survey is presented of water problems faced in different parts of Canada and new concepts related to water management are outlined. A review of Canadian experience in water management suggests that although in many respects it has lagged behind other countries in adopting new concepts, it has pioneered the development and adoption of a number of them. This introductory chapter presents a capsule summary of papers contained in the book. These papers focus upon five main issues: adjustment to flood hazard, institutions and conflict resolution, water demand, water quality management, and public participation and impact assessment.

066592
CAN INST RESOUR LAW * **Resources law bibliography** * 537p * Can Inst Resour Law * 1980.

This bibliography, containing items from the University of Calgary Law Library as of January 1980, includes references on resources law. It is divided into sections: general references; annuals and periodicals; natural resources including soils, land, forests and forestry, and wildlife; energy resources, including energy policy, solar energy, geothermal energy, hydroelectric power, tidal power, biomass, and refuse as fuel; oil and gas, including natural gas, petroleum, oil sands, and hazardous substances; nuclear energy, including international cooperation, and radiation and damage; mines and mineral resources, including mines and mining regulations, mineral industry, minerals in submerged lands, coal, sulphur, zinc, uranium, mercury, and gold; water resources, including development, water quality, water supply, and rivers; the ocean, including maritime law, ocean bottom, shore protection, coastal resources, marine resources, and fishes; the environment, including environmental laws, environmental policy and protection, and waste management; and pollution, including air and water pollution and oil pollution of water. For each entry, the classification number is provided to facilitate location at the University of Calgary Law Library. An author and a title index are also provided.

F11914
CONS CONSUL ENVIRON, GOUV QUE * **Avis sur le projet de reglement relatif aux eaux destinees a la consommation humaine** * 38p * Minist Environ, Cons consult environ, Gouv Que * 1982-11.

On presente l'avis du Conseil sur le Projet de reglement relatif aux eaux destinees a la

consommation humaine. Par le present projet de reglement, le ministere de l'Environnement desire rejoindre les trois objectifs qu'il s'est fixes, a savoir: mieux proteger la sante publique en adoptant des normes reconnues universellement et en creant l'obligation de fournir une eau potable; ameliorer l'efficacite de la surveillance en responsabilisant les exploitants; rejoindre le plus grand nombre possible d'exploitans. Le present avis precise la teneur des suggestions preconisees par le Conseil pour que l'eau destinee a la consommation humaine soit non seulement potable mais egalement agreable a boire.

F11431
CONS CONSULT ENVIRON, GOUV QUEBEC * **Avis sur le projet de loi no 55 intitule "Loi modifiant la Loi sur la qualite de l'environnement et d'autres dispositions legislatives"** * 46p * Cons consult environ, Gouv Quebec, Que * 1982-06.

Le 16 mars dernier, le ministre de l'Environnement presentait le "Projet de loi no 55" en premiere lecture a l'Assemblee nationale du Quebec. Ce projet de loi s'intitule "Loi modifiant la Loi sur la qualite de l'environnement et d'autres dispositions legislatives". Il comprend un total de 43 articles concernant principalement la Loi sur la qualite de l'environnement et la Loi sur le regime des eaux. Une analyse, article par article, a permis au Conseil consultatif de l'environnement de determiner les aspects de ce projet de loi qui meritaient le plus d'etre ameliores. Parmi les douze sujets retenus et commentes, le Conseil a accorde une attention speciale aux articles concernant l'instauration de la procedure d'attestation de conformite environnementale qui demeure l'objet principal de ce projet.

065359
DREISZIGER NF * **International water management in Canadian - American relations, 1894 - 1907** * Can Water Resour J * 8(3) 58-76 * 1983.

Until the first decade of the twentieth century Canada and the United States did not possess a set of comprehensive regulations for international water management along their common frontier. The need for such regulations arose during the 1890's and the early 1900's when accelerating population growth, industrialization and technological change resulted in new uses of waters along the U.S. - Canada international boundary. The proliferation of such uses threatened water management in the two countries with chaos. The threat was recognized by technical experts and was dealt with by the governments in Washington and Ottawa -- after innumerable delays. In the end comprehensive guidelines were agreed upon for the orderly development and preservation of common water resources. In 1909 they were incorporated into a treaty, providing North America with its first body of international law for international water management.

F10617
ENVIRON CAN * **Loi sur les ressources en eau, rapport annuel 1980-1981** * 46p * Approvision et services CA, Ottawa, Ont * 1981.

Le present rapport, neuvieme a etre presente, porte sur les realisations au 31 mars 1981 relatives a la gestion federale-provinciale des ressources en eau du Canada. Est donne en premiere partie un apercu des dispositions de la Loi, puis sont traites brievement les programmes particuliers qui ont ete ou qui doivent etre entrepris en application de ces dispositions; Les activites pour l'annee sont regroupees en 4 volets: 1) gestion integree des ressources en eau 2) gestion de la qualite des eaux 3) reglementation des apports de substances nutritives 4) programme d'information au public. De plus une section intitulee "evenements particuliers" donne un apercu des conditions de ruissellement au printemps de 1981 et presente un resume des etudes sur la secheresse dans les Prairies. De meme un tableau fait voir l'etat d'avancement des designations de zones a risques d'inondations dans le cadre du Programme de reduction des dommages causes par les inondations.

062305
ENVIRON CAN * **Canada water year book 1981-1982, Water and the economy** * 105p * Environ Can * 1983.

This edition of the Canada Water Year Book is the fifth in the series reporting on freshwater resources in Canada. The first edition, for 1975, provided broad general coverage of Canada's water resources. The second, for 1976, looked in detail at water management in Canada. The third, for 1977-1978, dealt with water data and described the field, office and laboratory programs producing water data. The fourth edition, for 1979-1980, provided an overview on water research across Canada. Unlike the last few editions that have carried a special theme, this latest edition, for 1981-1982, deals with a large number of subjects, each with its own special message.

F11409
ENVIRON CAN * **Loi sur les ressources en eau du Canada, rapport annuel, 1982-83** * 50p * Environ Can * 1983.

Ce onzieme rapport annuel decrit les realisations au 31 mars 1983 en ce qui concerne les principes de gestion federale-provinciale des ressources en eau du Canada. On traite des programmes mixtes entrepris en vertu du Programme national de reduction des dommages causes par les inondations ainsi que d'autres projets de regularisation, de

repartition, de controle et de releves des ressources en eau, et des phases d'etude preliminaire, de planification et d'application des programmes relatifs a la gestion des ressources en eau. On enonce les principales ententes federale-provinciales de collaboration dans le cadre de la Loi sur les ressources en eau du Canada.

066624
ENVIRON CAN * **The Canada Water Act annual report 1982-83** * 46p * Environ Can * 1983.

065520
ENVIRON CAN, INF DIR * **Environment Canada Annual Report 1981-1982** * 64p * Environ Can, Inf Dir, Ottawa, Ont * 1981-1982.

066627
ENVIRON CAN, ONT REG * **Response report, 1982 public consultation program** * 54p * Environ Can * 1983-03.

This report is a compilation of the comments and recommendations made by members of interest groups and the general public during Ontario Region's 1982 Public Consultation program. Five sessions were held in September -- one in Kingston, London and Sudbury, and two in Toronto. The sessions consisted of an afternoon open house and a formal evening meeting. The comments contained in this report were presented in the evening sessions, either as formal briefs or ideas raised in the workshops. A total of 26 briefs were presented by environmental groups and interested individuals, and participants attended a total of 13 workshops. The comments received have been organized according to subject category. The initials after each comment indicate its source. Unattributed comments are derived from a general consensus in the workshops. The names and affiliations of participants are listed at the end of the report. Departmental responses to each comment/recommendation have been incorporated in this report which will be distributed to senior management of Environment Canada, as well as all participants wishing copies.

063327
FINKLE PZR, LUCAS AR (ED) * **Environmental law in the 1980s: a new beginning, Proceedings of a colloquium convened by the Canadian Institute of Resources Law, The Banff Centre, November 27-29, 1981** * 233p * Can Inst Resour Law, Fac Law, Univ Calgary, 2500 Univ Drive Northwest, Calgary, Alta T2N 1N4 * 1982.

Despite the fact that most environmental legislation is cast in terms of prohibition and penalty, it is apparent that management and negotiation is in fact, the essence of Canadian environmental law. There is little role for common law actions that were designed only to resolve disputes between individuals. In this system, the role of government is central and the major emerging environmental law issues concern the rights of individual citizens and groups in environmental regulatory processes. There are major uncertainties and contradictions in the legal rights and duties of government and of citizens, and there is growing evidence that public concern about these problems is increasing. Particular problems include the possibility that certain new doctrines such as the emergent concept of procedural "fairness", and the "strict liability" quasi criminal offence category, stated in the Sault Ste. Marie case, may be used by polluters to frustrate environmental law enforcement. Despite early promise, there is now widespread public concern about the fairness and effectiveness of environmental impact processes. The rather tenuous relationship between scientific certainty and legal concepts of proof has also hampered development of effective environmental laws. A final major problem area is enforcement. Recent studies have shown that laws which are command/penalty in form are likely in practice to be enforced through a process of negotiation. This suggests that a rethinking of environmental laws may be necessary to reflect this reality and to make the bargaining mode fairer and more effective. However, it has been suggested that the line should be drawn at negotiating the basic legal environmental standards. Enforcement is also an important and difficult problem in international environmental law. A major conclusion is that redesign and rethinking of the legal framework for environmental decision-making are required. Legal rights, duties, and obligations of government in enforcement of environmental laws must be rendered more certain. The role of citizens in this process must also be clarified, and a greater public awareness of the techniques for environmental law enforcement must be achieved.

F10232
FRECHET L * **L'ingenieur et ... la qualite de l'environnement** * Ing * (355) 18-19 * Publ Ingenieur Inc, Montreal, Que * 1983-05.

L'essentiel des modifications de la loi numero 55 visait a rendre davantage responsables ceux qui participent a la realisation de projets susceptibles d'entrainer des repercussions sur l'environnement. Pour les ingenieurs, cette responsabilite accrue se traduit par une "attestation de conformite environnementale". Il s'agit plus precisemment de l'obligation de produire des plans et devis en accord avec les normes etablies par le Gouvernement et d'en attester par ecrit la conformite. Grace a la nouvelle loi, il sera desormais plus facile d'effectuer une surveillance et un controle soutenus et ce, directement sur le terrain.

065103
GARDNER PINFOLD CONSULT ECON LTD * **A study of water in the economy of Altantic Canada** * 69p * Gardner Pinfold Consult Econ Ltd * 1983-03.

This study substantiates the economic importance of water management in Atlantic Canada and also catalogues and quantifies the contribution that water dependent activities made to the economy of Atlantic Canada; provides information to be used as input to Inland Waters Directorate Atlantic's strategic planning activities; and identifies program areas for which new cooperative initiatives between IWD Atlantic and other public sector agencies seem appropriate. Estimates of water demand by user class and water supply by source are provided. Some of the study's findings include: 1) the Atlantic Region has abundant supplies of good quality water; 2) most water demand is met from surface sources; 3) from half to two thirds of households in the regions have access to municipal water systems; 4) the economic importance of water becomes apparent when the importance of water-dependent industrial activity is assessed; 5) the ten leading water dependent manufacturing industries account for about 75% of this sector's share of the gross domestic product (GDP); and 6) the food and beverage industry is the most important industry in the manufacturing sector in terms of share of GDP and share to total employment.

064905
GOV NFLD LABRADOR * **Managing all our resources, a development plan for Newfoundland and Labrador 1980-85** * 160p * Nfld Info Serv, Confederation Build, St John's, Nfld A1C 5T7 * 1980-10.

This report, covering the period 1980-1985, is a summary document of a detailed five-year plan prepared by each department of the Government of Newfoundland and Labrador covering the objectives, targets, policies, programs, and projected budgets. Following an introduction, the report describes the economy, outlining the structure, labour force characteristics, income and employment, and relationships to other economies, gives a five year outlook and growth forecast, and examines economic planning implications. A financial review and outlook are provided, including an analysis and forecast of current account revenues and expenditures and an outline of the Province's debt structure and borrowing levels needed to support the capital projects plans. Development potential by sector, related government programs and activities, major areas of social concern, and the Government's intentions and programs are examined. A summary of capital projects and a review of major issues, policies and programs, are also included.

063567
GREAT LAKES SCI ADVIS BOARD * **The appendices to the 1982 Annual Report Great Lakes Research Review** * 270p * Int Jt Comm, Great Lakes Reg Off, 100 Ouellette Ave, Windsor, Ont N9A 6T3 * 1982-11.

The seven appendices to the 1982 annual report on Great Lakes research which determined how fully the existing research effort is meeting the requirements of the 1978 Great Lakes Water Quality Agreement. The appendices cover the following areas: 1) correspondence - request for research information, verification of coded and classified information, and verification of research expenditure; 2) research agencies and organizations providing research information; 3) research needs - required by the 1978 Great Lakes Water Quality Agreement, recommendations of the Science Advisory Board, and of the Water Quality Board; 4) classification and coding system of research projects; 5) current research activities in the Great Lakes; 6) historical research activities in the Great Lakes; and 7) titles of projects, current and historical.

063565
GREAT LAKES SCI ADVIS BOARD * **Great Lakes research review annual report 1982** * 66p * Int Jt Comm, Great Lakes Reg Off, 100 Ouellette Ave, 8th floor, Windsor, Ont N9A 6T3 * 1982-11.

This report determines how fully current research efforts are meeting the requirements of the Great Lakes Water Quality Agreement of 1978 and identifies research needs which are not adequately addressed by the existing effort. Ten specific high priority research needs are highlighted: 1) epidemiological studies (human health); 2) health of aquatic communities; 3) atmospheric pollution indicators; 4) polynuclear aromatic hydrocarbons and toxaphene; 5) structure-activity correlations; 6) tissue and sediment banks; 7) computer modeling and validation; 8) phosphorus management; 9) groundwater contamination; and 10) socio-economic considerations. Results of the review of project descriptions and workplans supplied by more than 25 research institutions in Canada and the United States identify water quality problems and areas of activity or sources of water pollution. Expenditures for research by research problem and area of activity are also included.

065452
GRIMA AP * **Public participation in Great Lakes policy making: an overview** , IN: Coastal Studies in Canadian Geography * Papers presented at a special session of the Can Assoc Geogr Annu Conf, Montreal, Que, May, 1980 * MCCALLA RJ * St Mary's Univ, Occas Pap in Geogr; Coastal Stud in Can Geogr No 4 * 62-88 * St Mary's Univ, Halifax, NS B3H 3C3 *

1980-11.

This paper first summarizes the importance of the Great Lakes in terms of geography, economy and natural resources; this descriptive background of the region indicates the potential conflict among users and identifies the major public(s). The second part of the paper is more theoretical in its scope and addresses the question "what is the role of public participation in formulating public policy about the Great Lakes?" The third part of the paper focuses upon some recent experiences in public consultation, related to the Great Lakes; the fourth part of the paper asks in a speculative fashion whether the scope of public publication could be met more adequately.

063275
GRIMA AP, MASON RJ * **Apples and oranges: toward a critique of public participation in Great Lakes decisions** * Can Water Resour J * 8(1) 22-50 * 1983.

The opportunities for concerned citizens to become involved in Great Lakes planning are increasing. It is opportune to review critically the quality of the public involvement programmes. This critique is accomplished in three steps. First we discuss the theoretical rationales for public involvement. Second, we examine the alternative approaches to the evaluation of public involvement. These sections provide a context for the third part: the case study on the PLUARG (Pollution from Land Use Activities Group) public involvement programme which is evaluated in terms of effectiveness, representatives of participants, interest of participants, public input to the final report, timing and accountability of the process. The analysis points to the risk of self-serving evaluations and to the need for ongoing and independent evaluations of public involvement programmes.

064005
HOLLAND JZ, CHEN W, ALMAZAN JA, ELDER FC * **Atmospheric boundary layer** (see chapter 4.4 for complete reference - voir chapitre 4.4 pour la reference complete)

063278
INLAND WATERS DIR, PAC YUKON REG, ENVIRON CAN * **Social and economic aspects of British Columbia inland waters** * 50p * Environ Can, Environ Conserv, Inland Waters Dir, Pac Yukon Reg, Vancouver, BC * 1983-04.

The combined mean annual flow of all streams in British Columbia is approximately one-fifth that of Canada. This vast inland water resource has had a profound impact on the social and economic growth and development of the region. Water resources contribute to the British Columbia economy by providing municipal and industrial water supply, irrigation water, water for recreation and transport purposes, and most of the electric power. The purpose of this report is to outline the importance of inland waters in the social and economic development of British Columbia; identify some current and future issues in the management and development of British Columbia inland waters; and to discuss the federal role in managing inland water resources.

F11362
INST NATL RECH SCI, INRS-EAU, UNIV DU QUEBEC * **Rapport annuel INRS-Eau 1981-1982 (1er juin 1981 - 31 mai 1982), 13e rapport annuel** * 106p *Inst natl rech sci, INRS-Eau, Univ Quebec, CP 7500, Sainte-Foy, Que G1V 4C7 * 1982.

Les programmes de recherche et d'enseignement de l'INRS-Eau ont connu l'evolution attendue durant l'exercice 1981-1982. Conformement au plan triennal de developpement (1979-1982), les activites de recherche se sont realisees dans le cadre de quatre programmes comprenant 40 projets: hydrologie deterministe et statistique; assainissement; effets de l'utilisation et de l'amenagement des ressources naturelles sur la dynamique des processus chimiques et biologiques en milieu aquatique; methodologies d'amenagement et de gestion de la ressource eau.

062340
LEE BJ, REGIER HA, RAPPORT DJ * **Ten ecosystem approaches to the planning and management of the Great Lakes** * J Great Lakes Res * 8(3) 505-519 * 1982.

During the past decade or so, many researchers, planners and managers the world over have propounded some version of "ecosystem approach" for problems and opportunities with the natural environment and renewable resources. Most of these approaches share the following features: a primary focus on ecological phenomena as opposed to engineering, economic, or jurisdictional phenomena; a perception of some self-regulatory capacity on the part of an ecosystem; a recognition of the marked responsiveness of many ecological systems to natural and human activities; and a readiness to strike a pragmatic compromise between detailed reductionistic understanding and more comprehensive, holistic meaning. Great Lakes workers are now trying to implement operational and institutional forms of ecosystem approach. Ten of these initatives are assessed here, taken from all government levels, directed toward open lake, coastal, and hinterland components of the basin. This comparison illustrates the range of proposals now under consideration in the basin and identifies their common elements. We offer these features as defining criteria of an ecosystem approach with the suggestion that

thoroughgoing synthesis or standardization be avoided. Flexible eclectic progmatism is, we suggest, the most productive attitude toward Great Lakes environmental problems.

066618
MANITOBA ENVIRON COUNC * **Manitoba Environmental Council Annual Report 10:1982** * 68p * Manitoba Environ Counc, Box 139, 139 Tuxedo Ave, Winnipeg, Man R3N 0H6 * 1982-10-22.

064515
CACCIA C * **Notes for an address by the Honourable Charles Caccia, Minister of the Environment, at the 8th Annual Applied Geography Conference, Ryerson Polytechnical Institute, Toronto, Ontario, October 14, 1983** * 10p * Minist, Environ Can * 1983-10-14.

Environment Canada has officially adopted an "ecosystem approach" which reflects that we are part and parcel of the environment. When we create wastes, they are not being disposed of into an environment external to society, but are being redistributed within an ecosystem or biosphere of which we are part. The ecosystem approach has had a profound impact in the Great Lakes Basin. Pollutants do not recognize national, provincial and state boundaries, and effective pollution control calls for inter-jurisdictional cooperation. The Boundary Waters Treaty of 1909, between Canada and the United States, states: Boundary waters...shall not be polluted on either side to the injury of health or property on the other side", and the Great Lakes Water Quality Agreements of 1972 and 1978 are even more specific. The Love Canal is the most highly visible aspect of the toxics problem, and remedial and preventative actions must be taken quickly. Other problems discussed are phosphorus control, acid rain, and the global greenhouse effect from CO2. The International Joint Commission cannot enforce its recommendations without the cooperation of the jurisdictions concerned. The Great Lakes ecosystem provides a microcosm of the environmental dilemma facing the world today. Perhaps only a global organization such as the UN, if it can be made to work effectively, can truly oversee our common biosphere.

065446
MITCHELL B * **Comprehensive river basin planning in Canada: Problems and opportunities** * Water Int * 8(4) 146-153 * Lausanne, CH * 1983.

River basin planning is falling into disrepute because of a frequent failure to make the transition from planning to implementation. Four reasons have contributed to this problem. First, it appears that comprehensive plans may not be required for all basins. Second, recommendations often are too numerous, ambiguous or abstract to help implementing agencies. Third, lengthy periods of time, needed to facilitate public participation and accountability, are used during planning. Fourth, adequate institutional arrangements do not exist to facilitate coordination of management functions and activities during both planning and implementation. Examples of these problems are presented from river basin management experiences across Canada.

063277
MITCHELL B * **River basin planning: problems, opportunities and implications for Ontario conservation authorities** * Can Water Resour J * 8(1) 1-21 * 1983.

River basin planning is falling into disrepute because of a frequent failure to make the transition from planning to implementation. Four reasons have contributed to this problem. First, it appears that comprehensive plans may not be required for all basins. Second, adequate institutional arrangements do not exist to facilitate coordination of management functions and activities during both planning and implementation. Third, lengthy periods of time, needed to facilitate public participation and accountability, are used during planning. Fourth, recommendations often are too numerous, ambiguous or abstract to help implementing agencies. Examples of these problems are presented from river basin management experiences across Canada. Their implications are reviewed for the ongoing development of watershed plans by each of the thirty-nine Ontario Conservation Authorities.

059657
MUNTON D * **Political, bureaucratic and legal solutions and constraints in environmental policy: a comment on Kirby, Pross and Lax** . IN: Water and Environmental Law, Proc Conf Dalhousie Univ, Halifax, NS, September 14-16, 1979 * 193-197 * Inst Resour Environ Stud, 1312 Robie St, Dalhousie Univ, Halifax, NS B3H 3E2 * 1981.

This report reviews three papers presented at this conference by M Kirby, A P Pross and C Lax respectively, and points out similarities and differences. Similarites include: 1) a substantial degree of consensus on the seriousness of environmental problems and the need to find solutions; 2) current institutions and processes are not successfully controlling environmental pollution; 3) support of a greater public role in environmental policy making; and 4) the public is seen as the source of ultimate weakness in environmental policy. Differences include: 1) corrective measures follow from the perspective adopted which are not only a reflection of personal or disciplinary bias but also of different notions as to what principles should be at stake and where power

lies in environmental issues and from differing perceptions of the strengths and weaknesses of the combatants in environmental policy making; and 2) the essential nature of the environmental policy making process. Some faults in the three papers are also discussed: 1) all overlook or play down the role of polluters; 2) all exaggerate the weaknesses of the insititutions they examined; and 3) all ignore the weaknesses of the institutions they examined; and 4) all ignore crucial dilemmas inherent in the arguments they advance.

063593
NICHOLSON HF * **Great Lakes Fisheries Research Branch annual review 1981** * 99p * Dep Fish Oceans, Great Lakes Fish Res Branch, 867 Lakeshore Rd, PO Box 5050, Burlington, Ont L7R 4A6 * 1981.

The Great Lakes Fisheries Research Branch (GLFRB) until recently the Great Lakes Biolimnology Laboratory, is the research wing of the Ontario Region of the Pacific and Freshwater Fisheries of the Department of Fisheries and Oceans. The GLFRB program is intimately involved with the other components of Great Lakes research conducted by a number of federal services of the Department of the Environment, e.g., National Water Research Institute, Ontario Region of the Inland Waters Directorate, Environmental Protection Service, Canadian Wildlife Service, National Health and Welfare, and provincial agencies such as Ontario Ministry of Natural Resources and Ministry of the Environment. Through further involvement with the International Joint Commission and the Great Lakes Fishery Commission, the Branch has direct dealings with U.S. federal and state agencies involved in Great Lakes research. GLFRB's major program on the Great Lakes is conducted under three program areas defined as Surveillance, Environmental Toxicology, and Ecosystems, with the conduct of the Acid Rain Program under Ecosystems. The results of individual projects within these three program areas are given in the descriptions of the Laboratory's activities, stressing the results of projects in the fiscal year 1981-1982.

066029
NS DEPUTY MINIST COMM LAND USE POLICY, WATER ISSUE GROUP * **Water supply: a resource in need of protection** * 30p * NS Deputy Minist Comm Land Use Policy * 1981-02.

This report discusses the need to protect Nova Scotia's water supply. The cheapest and best way to ensure the best possible water quality is to ensure the water entering a treatment plant is of as high a quality as possible. In watershed areas from which public water supply is drawn, water quality protection must be the primary objective and all other land use objectives secondary. This report deals with the sources of water supply and their accompanying problems. Various management options presently available and how they are being used are also covered in the report. The report also sets out how a watershed management strategy is developed. Changes are needed in legislation concerning watershed areas and development in such areas. The division and co-ordination of responsibilities between the municipal and provincial governments needs changes. Public involvement is vital in all aspects of decision-making and management of municipal watersheds.

066595
OLDING BJ * **Approaches to comprehensive water resource management for the Province of Alberta** * Alberta Environ, Res Manage Div * 270p * 1981-02-15.

This project examines a comprehensive approach to effective management of water resource problems in Alberta. These problems include competing demands for water resource allocation, deteriorating water quality in surface watercourses, and degraded environmental resources associated with watercourses. Traditionally, water resources have been managed by separate government agencies employing regulatory measures and flow regulation structures. A comprehensive approach to water resource management anticipates conflicts, and formally incorporates the views of various government agencies and water resource users during the formulation and evaluation of solutions to identified problems. The relevant water resource legislation and management activities and responsiblities of government agencies in Alberta are discussed. Matrix organizations are evaluated for their ability to facilitate the integration of management objectives among government agencies. Formal water resource planning procedures intended to incorporate the views of water resource users into the decision making process and to overcome the limitations of environmental overviews in project evaluation are described. The effectiveness of economic incentives, including higher water charges to decrease the demand for irrigation and municipal water supplies and effluent charges to decrease the demand for effluent disposal, are evaluated. Water quality planning is discussed with reference to allocating watercourses to particular uses and to selecting water quality objectives and effluent standards based on those uses. Problems associated with benefit-cost analysis are discussed. Also examined is the issue of compensating resource users for degraded or lost environmental resources associated with the construction of water resource projects.

F10233
PECHES OCEANS * **L'Institut des eaux douces** * PUB-81/022F * 23p * Peches Oceans, Dir commun, Ottawa, Ont * inconnu.

L'Institut des eaux douces a Winnipeg est un centre national de recherches en biologie aquatique et sur les peches en eau douce; il est situe sur le campus de l'Universite du Manitoba. Les programmes de recherche et les activites de l'Institut ont un objectif commun, soit celui d'assurer la conservation et l'utilisation efficace des ressources halieutiques. Les scientifiques de l'Institut tentent d'evaluer les incidences des activites humaines sur les lacs, les rivieres et autres cours d'eau, c'est-a-dire les incidences de la societe industrielle sur les ecosystemes des eaux douces. Pour plus de renseignements, s'adresser a la Dir commun, Minist Peches Oceans, Inst eaux douces, 501 University Crescent, Winnipeg, Man R3T 2N6.

061944
PRAIRIE PROV WATER BOARD * **Prairie Provinces Water Board Annual Report 1981-1982** * 67p * Prairie Prov Water Board, 306 - 1901 Victoria Ave, Regina, Sask S4P 3R4 * 1982.

On October 30, 1969 Canada and the Provinces of Manitoba, Saskatchewan and Alberta entered into an agreement to share the flow and to consider the quality of eastward flowing interprovincial streams. Under Schedule C of that Master Agreement on Apportionment, the Prairie Provinces Water Board was reconstituted and was given the responsibility to administer the Agreement. The Board met twice in the last fiscal year. The first meeting was held on May 6-7, 1981 in Winnipeg. The second meeting was held on November 18-19, 1981 in Regina. There were no changes in Board membership in the past year. In the last fiscal year; the Committee on Hydrology met three times, the Committee on Water Quality four times, the Committee on Water Demand five times, the Committee on Interjurisdictional Agreements Administration once, and the Committee on Groundwater twice; a total of fifteen committee meetings. This report summarizes the activities and the progress of the Prairie Provinces Water Board, its Committees, and the Secretariat for the period April 1, 1981 to March 31, 1982.

064009
RICHARDS TL, AUBERT EJ * **The International Field Year for the Great Lakes - an introduction** , IN: IFYGL - The International Field Year for the Great Lakes * AUBERT EJ, RICHARDS TL * 1-14 * Natl Oceanic Atmos Adm, Great Lakes Environ Res Lab, US Dep Commer, Ann Arbor, MI 48104 US * 1981-03.

This chapter explains the history and rationale of the International Field Year for the Great Lakes, focusing on the cooperation between Canada and the United States in the management of the Great Lakes water resources to serve the growing needs of the region. The need for a field year, foreseen since the mid-1960's, sponsored by the newly-established United Nations International Hydrologic Decade, and the birth of this program (spanning April 1, 1972 - March 30, 1973) including the Steering Committee stage and the choice of Lake Ontario as the lake to be studied, are described. Development and planning of the field program, project proposals, scientific panels, workshops and technical plan, are discussed, as well as the management aspect including funding, joint management team, data collection policy, data archiving policy, and publication policy. A brief resume of some of the major facilities established and operated during the Field Year is presented covering water, land and air operations, and field operations. The intense scientific data collection activities of the Program are outlined. The ensuing years of the Program following the data collection phase, including presentation and publication of findings, and wrap-up workshop, are also reviewed.

065797
SLATER JE, TRAVERSY WJ, PENTLAND RL * **Canada's Inland Waters Directorate** , IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * v2 1025-1038 * Can Soc Civ Eng * (1983).

In Canada the management responsibilities for water are shared between the provinces and the federal government. The federal organization is the Inland Waters Directorate (IWD) of Environment Canada. The water strategies and programs of three operational branches and the mechanisms and policies by which they are carried out are outlined and discussed in this paper.

063057
THOMPSON AR (CHAIRMAN) * **Northern Conservation Policy Workshop, Whitehorse, Yukon, February 27 - March 2, 1983** * 20p * Banff Cent, Sch Manage * (1983).

Participants at the Northern Conservation Policy Workshop were asked to develop the elements of a conservation policy for the north and a long range action plan setting out goals for the implementation of such policy. A draft discussion paper, entitled "A Comprehensive Conservation Policy and Strategy for the Northwest Territories" provided the basis for the workshop discussion. The workshop considered the subject from the standpoint of desirable futures. It then addressed the obstacles and constraints that could impede the attainment of the desired goals. Finally, the workshop looked at how those obstacles could be overcome and made recommendations as to how the goals and objectives of a comprehensive conservation policy could be achieved. An Action Plan for Northern Conservation is presented. It is intended to complement and encourage current conservation initiatives in northern Canada.

064481
THOMPSON AR * **Environmental regulation in Canada: an assessment of the regulatory process** * 130p * Univ British Columbia, Westwater Res Cent, Vancouver, BC * 1980.

An overview of case studies and theme papers dealing with environmental issues in Canada is presented. The role of government in relation to the environment can be more effectively analyzed and better solutions achieved if the government is a manager as well as a legislator, particularly when dealing with publicly-owned natural resources.

064412
VALLENTYNE JR * **The ecosystem approach to planning, research and management in the Great Lakes Basin** . IN: International Association of Theoretical and Applied Limnology, Proceedings, JP, 1980 * SLADECEK V * 21(3) 1749-1752 * E Schweiz Verlagsbuchhandlung, D-7000 Stuttgart 1, DE * 1981.

The ecosystem approach to planning, research and management in the Great Lakes Basin is explained, obstacles to its implementation in the Basin outlined, removal of some of the obstacles suggested, and the extent to which the ecosystem approach may be applicable elsewhere examined. The ecosystem approach, which is based on a philosophy and ecological framework for a preventive approach to environmental problem solving, is seen to have four obstacles to its implementation: habit/tradition, emergent properties, flow/interactions, and crossing interfaces. Three actions thought to be useful to overcome these obstacles - public education, scientists as enzymes, and conservational pricing - are described. The application of this approach to developing nations, is also outlined.

064081
WALLER DH * **Upstream-downstream: Rights and responsibilities** * Can J Civ Eng * 10(3) 362-368 * 1983-09.

A lengthy trial in the Supreme Court of Nova Scotia may influence design of future stormwater systems in Canada. The developer of a 203 ha area sued an upstream developer and the provincial department of transportation, claiming real and anticipated damages from increased flows and volumes of stormwater. The plaintiff claimed that it was entitled to have the defendants reduce quantities and rates of flow, or to have costs of enlarging its system paid by the defendants. The Court concluded that the defendants were not required to restrict flows to pre-development levels as long as they used natural watercourses and did not cause their natural capacity to be exceeded. The paper discusses the implications of these findings and their relationship to requirements of storm drainage design criteria developed by a municipal-provincial drainage task force.

2. RESOURCE STUDIES - ETUDES DES RESSOURCES

061978
The mighty Mackenzie River * Beaufort * 1(2) 5-7 * Dome Pet Ltd, Box 200, Calgary, Alta T2P 2H8 * 1981-11.

A description of the Mackenzie River, which flows into the Beaufort Sea, as main transportation route at all times of the year for oil industry operations, the never-ending process of deposition of suspended sediments yielding large quantities of oil and metals, and the wildlife gathering feature of the Mackenzie Delta with its rich supply of food and shelter, is presented. Drilling waste disposal and its impact on the sea floor life, is discussed. Oil industry surveys of the River are examined focusing on the finds of oil and gas traps, and the burial of sand and gravel which could be harvested for building. The effect of ice breakup in the Delta on the beluga whale population is reviewed. The interlinking of man's and wildlife's activities in the Mackenzie River and the feeling that man's search for oil is a mere flash compared to the timeless flow of the river, are explored.

064848
ALBERTA ENVIRON PLANN DIV * **Environmental considerations in the Saskatchewan-Nelson basin: Alberta, Prairie Provinces Water Board water demand study** * 218p * Alta Environ Plann Div, 9th Floor, Oxbridge Place, 9820-106 St, Edmonton, Alta T5K 2J6 * 1982-03.

The study provides an overview of environmental considerations for the five major river sub-basins that form the Alberta portion of the Saskatchewan-Nelson Basin. These include the North Saskatchewan, Red Deer, Bow, Oldman and South Saskatchewan river sub-basins. Environmental considerations for each river sub-basin are discussed separately with respect to hydrology, water quality, fish habitat, wildlife habitat, other instream uses of water and the significance of river discharge to these conditions. This report is supplemented by maps of fish and wildlife habitat of the sub-basins. Within the limitations imposed by the information base, flow guidelines for aquatic habitats are presented and currently recognized flow objectives are evaluated. The information presented in this volume is derived from existing sources. It must be recognized that this study, because of the limited data base and the overview nature of the study, has provided only a superficial analysis of the environmental considerations.

063996
AUBERT EJ, RICHARDS TL (ED) * **IFYGL - The International Field Year for the Great Lakes** * 410p * Natl Oceanic Atmos Adm, Great Lakes Environ Res Lab, US Dep Commer, Ann Arbor, MI

48104 US * 1981-03.

This book summarizes and synthesizes the scientific results of the International Field Year for the Great Lakes, a joint Canada-United States interdisciplinary program investigating the physical, chemical and biological aspects of Lake Ontario. The results of the scientific programs of the seven panels - lake meteorology, atmospheric boundary layer, terrestrial water balance, energy balance, water movement, biology and chemistry, and evaporation synthesis - are summarized. The Meteorology Program is subdivided into chapters dealing with meteorological analyses, precipitation and atmospheric water balance, and the Biology and Chemistry Program into chapters dealing with biology, materials balance, and ecosystem and water quality modelling. The concluding chapter provides an overview of the major accomplishments of IFYGL, and a synthesis of results. Three appendices, covering the bibliography, organization, and archives provide additional information.

063997

AUBERT EJ, RICHARDS TL * **Summary of accomplishments** , IN: IFYGL - The International Field Year for the Great Lakes * AUBERT EJ, RICHARDS TL * 367-384 * Natl Oceanic Atmos Adm, Great Lakes Environ Res Lab, US Dep Commer, Ann Arbor, MI 48104 US * 1981-03.

This summary chapter presents the major objectives, the measurement program, and significant accomplishments of each program of the International Field Year for the Great Lakes, a joint U.S.-Canada experimental and theoretical research program dealing with hydrology, meteorology and limnology of Lake Ontario and its basin. Programs discussed are meteorolgy (meteorological analyses, precipitation, and atmospheric water balance), atmospheric boundary layer, energy balance, terrestrial water balance, evaporation, synthesis, water movements, and biology and chemistry (materials balance and ecosystem and water quality modelling). Major IFYGL accomplishments are highlighted including its international nature, evaporation synthesis, intermittencies, interdependencies of the atmosphere, lake and basin, seasonal cycles, publications, and the IFYGL archives. Highlights of critical and essential multidisciplinary research recommendations extracted from the Wrap-Up Workshop proceedings of October 1977, are presented. It is concluded that although a great deal was accomplished, significant research still remains to be done.

065859

BACCHUS A * **Physical characteristics of the Avon River** * Stratford/Avon River Environ Manage Proj Tech Rep S-2 * 29p * Ont Minist Environ, 985 Adelaide St S, London, Ont N6E 1V3 * 1982-10.

As part of the Stratford-Avon River Environmental Management Project, the River Systems Unit of the Ontario Ministry of the Environment carried out surveys during the summers of 1980 and 1981 to collect data on the physical characteristics of the Avon River. Data from these surveys are to be used in the development of a mathematical model to predict water quality changes under different management scenarios. Standard methods for measuring channel geometry, time of travel and streamflow were used. Results indicate that riffle-to-pool distance varied from 325 m to 550 m; average depth between reaches was consistent, ranging from 0.17m to 0.35m; and average width varied from 11.82 m to 20.31 m. Streamflow was observed to range from 0.04 cu m/sec to 63.7 cu m/sec at Station 10 during the period 1965-1979. Time of travel ranged from 4 to 10 hours depending on the reach, with total time of travel for the river downstream of Stratford varying from 26 hrs to 74 hrs, depending on flow. Reductions in flow observed between two downstream stations were attributed to anomalies in the operation of the Stratford WPCP. Substrate type was homogeneous throughout the river below Stratford although aquatic plant communities varied from reach to reach.

062632

BEAK CONSULT LTD * **Stream and tributary inventory at Cat Arm** * vp * Beak Consult Ltd, Box 367, St John's, Nfld A1C 5J9 * 1981-11.

This report presents the September 1981 field survey conducted in the Cat Arm River system, on the Great Northern Peninsula, Newfoundland. The survey inspects potential barriers to fish migration in the reservoir tributaries. It quantifies rearing habitats, and investigates the utilization of these habitats by resident stream trout. Four waterfalls on three tributaries located upstream from the reservoir are classified as complete or partial barriers. It appears both technically and economically feasible to render these falls passable to brook trout by dynamiting. About 2100 units, or 23%, of the stream rearing habitat and many small and large headwater ponds are found above the four barriers. Electrofishing both above and below the barriers indicates that the abundance of brook trout is typical or above average for the Island. These trout are small, short-lived and have a low fecundity; however, the potential egg deposition per unit of habitat appears to be high. It is felt that both brook trout and arctic char will develop in the Cat Arm Reservoir.

065788

BEESLEY NH, GARRAWAY MD * **Moira River water management study** , IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceeding, June 2 & 3, 1983, Ottawa,

Ont * TOWNSEND RD * v2 847-865 * Can Soc Civ Eng * (1983).

A water management study conducted for the lower half of the Moira River drainage basin is reviewed. The study is divided into four parts: (1) Acquisition of digitized flood plain mapping, (2) Characterization of flood prone areas, (3) Special examination of ice jam related flooding, and (4) Identification of alternative water management programs.

F10945
BOUCHER R, LEMIRE R * **Description generale du bassin de la riviere Desaulniers et des stations echantillonnees en 1976, 1977 et 1978** * 20p * Soc energie de la Baie James, Montreal, Que * 1980.

Dans le cadre des travaux d'amenagement hydroelectrique du Complexe La Grande situe sur le territoire de la Baie James, le reservoir Desaulniers constitue un laboratoire naturel qui permet de connaitre les modifications entrainees par la creation d'un lac de barrage, sur la flore et la faune aquatique de cette region. Ce rapport fait suite aux donnees recueillies en 1976 relatives aux differents aspects des ecosystemes aquatiques, depuis l'etude du milieu physique jusqu'aux poissons, en passant par les differents elements de la chaine trophique. Les resultats presentes sont ceux de 1977 et 1978 soit apres la mise en eau du reservoir Desaulniers.

F10318
CARDY WFG * **Region d'amenagement d'Edmundston, etude des ressources en eau** * Rapp I-8104 * 121p * Minist environ, Dir ressources eau, NB * 1981-09.

Le present rapport sur les ressources en eau de la region d'amenagement d'Edmundston met en lumiere le fait suivant: bien qu'elles soient situees le long du fleuve et de ses principaux affluents, la plupart des municipalites de la region dependent des eaux souterraines pour leur approvisionnement. Ce rapport est le premier document visant a rassembler des renseignements sur les ressources en eaux souterraines et a les rendre accessibles. Recemment, d'importantes sommes d'argent ont ete consacrees a l'etude et a l'amenagement de services publics d'approvisionnement en eau a Baker Brook, Edmundston, Saint-Andre, Sainte-Anne, Saint-Basile, Saint-Francois, Saint-Hilaire et Saint-Jacques. Ces etudes ont ete entreprises en vue d'augmenter les ressources dans les municipalites grace a l'appui financier de l'Accord general sur le developpement. La principale preoccupation consiste maintenant a s'assurer que les reserves d'eau soient exploitees avec prudence et que leur rendement soit controle. Il importe en effet de controler les niveaux de pompage dans les puits de production et de verifier les fuites dans les systemes d'approvisionnement afin d'evaluer la performance de ces systemes. Ces mesures de controle aideront a etablir la consommation quotidienne par habitant qui semble depasser la moyenne de la province dans plusieurs municipalites de la region d'amenagement. La qualite de l'eau dans la region d'amenagement d'Edmundston est generalement bonne. Cependant, les reserves en eaux souterraines que l'on trouve dans les depots alluviaux du bassin plus profond du fleuve ont tendance a presenter un taux plus eleve de manganese. Cette situation peut soulever des problemes d'ordre esthetique, comme le fait de salir les installations sanitaires et la lessive, mais n'occasionne pas de problemes de sante.

F11189
CARTER D * **Ville de Hull, port de plaisance, considerations techniques** * 40p * Comm Cap natl * 1982-02.

La Commission de la Capitale nationale projette l'implantation d'un port de plaisance sur la rive quebecoise de la riviere des Outaouais, entre les ponts Interprovincial et Cartier McDonald. L'actuel quai de Hull s'integrerait dans le nouvel amenagement portuaire destine a la plaisance. Le choix de l'emplacement d'un port de plaisance doit etre evalue sous le triple point de vue suivant: considerations techniques; conditions de frequentation; coherence avec l'amenagement du secteur. Le mandat de cette etude, confie au consultant en novembre 1981, se limite au premier aspect, a savoir les considerations techniques. Les contraintes techniques comprennent: fluctuation du plan d'eau; vents; vagues; conditions de glace; courants; qualite de l'eau; bathymetrie.

O65846
COLEMAN DE * **Identification of priority management areas in the Avon River watershed** * Stratford/Avon River Environ Manage Proj Tech Rep R-4 * 71p * 1982-11.

The Avon River watershed near Stratford, Ontario, has been identified as having a significant non-point source contribution from rural areas. This study identifies the factors contributing to diffuse source loads, estimates the contribution of each, and locates problem or priority management areas. The Universal Soil Loss Equation (USLE) was applied to calculate average annual soil loss. Monitoring data collected for the Stratford Avon Environmental Management Project were used to derive micro-delivery ratios for the watershed. The USLE factors for crop/cover, soil erodibility, slope and slope length were mapped as were farm property boundaries and sub-watershed units. By overlaying these maps using computer techniques, approximately 4,400 erosion polygons were derived. Associated with each is the micro-delivery ratio, the proportion of the gross erosion which reaches the stream from that erosion polygon. Using

this set of information the following results were derived. On 16,200 hectares comprising the watershed, some 6,200 tonnes of suspended sediment and 5.8 tonnes of total phosphorus are loaded to the Avon River each year. This material is supplied by an average of 83,000 tonnes of erosion which occurs annually. The highest erosion loss occurs on slopes above 20% in continuous corn. All land with slopes exceeding 2% on which continuous row crops, corn rotation systems or mixed systems occur, have erosion rates exceeding 10 tonnes per hectare per year. The 1,350 hectares on which this combination of crop and slope occurs is responsible for producing 31,000 tonnes of the erosion occurring in the watershed. The same area produces approximately 85% of the suspended solids load and 75% of the total phosphorus load. Techniques that appear to be beneficial in reducing erosion, suspended solids loading and total phosphorus loading are cross-slope tillage, cross-slope tillage with strip-cropping, mulched tillage and introducing rotations into continuous row cropping systems. Given information regarding the practicality of implementing such techniques, and figures indicating the costs and benefits in terms of agricultural production, management of high priority areas could be implemented by treating about 8% of the watershed. Depending upon the remedial practices chosen, erosion, suspended solids loading and total phosphorus loads in the entire watershed could be reduced by 10 to 60%.

F10505
COM CONSULT POUR L'ENVIRON DE LA BAIE JAMES * **Comite consultatif pour l'environnement de la Baie James, rapport annuel 1979-1980** * 31p * Com consult pour l'environ de la Baie James, Montreal, Que * 1981.

Ce rapport annuel decrit, dans une premiere partie, les activites du Comite consultatif pour l'environnement de la Baie James au cours de l'annee 1979-1980, tandis que la seconde partie fait etat des activites du Comite d'evaluation. Ce dernier est place sous la surveillance administrative du Comite consultatif, en vertu des dispositions de la loi et de la convention. Le Comite a tenu six reunions au cours de sa deuxieme annee d'activites et les discussions ont porte, entre autres, sur l'exploitation forestiere, les precipitations acides, les services municipaux en territoire cri, des projets de reglementation provinciaux, la formation des administrateurs locaux et la consolidation administrative du comite.

F10210
COMM CHARGEE DE L'AMENAGEMENT DU BASSIN DE L'OKANAGAN, CB * **Rapport sommaire sur l'Accord sur l'execution du plan d'amenagement du bassin de l'Okanagan** * 34p * Comm chargee de l'amenagement du bassin Okanagane, CB * 1982-09.

Une etude de la gestion des ressources hydriques du bassin de l'Okanagan, entreprise sur une periode de quatre ans par la commission consultative du Canada et de la Colombie-Britannique, a ete terminee en 1973. Cette etude a servi de base a un certain nombre de recommandations portant sur un plan d'ensemble de gestion des eaux. Ce rapport sommaire met en relief les resultats signales dans le rapport sur l'Accord concernant l'amenagement du bassin de l'Okanagan.

F11759
CYR M * **Ecologie, principes de base** * 308p * Ed Renouveau pedagogique inc, Montreal, Que * 1981.

Cinq grands themes eux-memes subdivises en sections specifiques composent ce manuel de base; ces titres se lisent comme suit: 1) interactions entre les etres vivants: les changements dans l'environnement, les niches ecologiques et les adaptations, les changements et equilibres dans le reseau alimentaire 2) les biomes terrestres: les biomes et les plantes climax, les adaptations chez les plantes climax, les reseaux alimentaires dans les biomes 3) les ecosystemes aquatiques: les proprietes de l'eau, les ecosystemes d'eau douce, l'ecosysteme marin 4) le sol et l'ecosysteme: les sols, la communaute du sol, de la roche a la terre 5) desiquilibre d'un ecosysteme: les limites d'un ecosysteme equilibre, la pollution et les besoins en nourriture, la pollution industrielle, la pollution et l'augmentation des dechets humains.

064003
DECOOKE BG, WITHERSPOON DF * **Terrestrial water balance** , IN: IFYGL - The International Field Year for the Great Lakes * AUBERT EJ, RICHARDS TL * 199-219 * Natl Oceanic Atmos Adm, Great Lakes Environ Res Lab, US Dep Commer, Ann Arbor, MI 48104 US * 1981-03.

The Terrestrial Water Balance Program was an essential part of the International Field Year for the Great Lakes (IFYGL). By using the terms of the water balance measured with the accuracy possible by current technological methods, the hydrologic cycle on Lake Ontario and its basin could be studied. Since evaporation from the lake surface is not easily measured, it was obtained as a residual from the water balance equation. This report documents the methods used and summarizes the estimates of the water balance terms for weekly and monthly periods of IFYGL. The impact of possible errors on the estimate of the evaporation terms is discussed briefly. The basic data used in this study are available from the Canadian IFYGL Archive, Canada Centre for Inland Waters, Burlington, Ontario, and from the United States IFYGL Archive at the National Climatic Center, Asheville, N.C.

F10566
DEMERS JJ * **Repertoire des etudes des rivieres du Quebec, 7 volumes** (see chapter 4.13 for complete reference - voir chapitre 4.13 pour la reference complete)

F10604
DIR DE L'ENVIRON LES CONSULTANTS SOGEAM INC * **Etablissement et caracterisation de stations-temoins (geomorphologie) sur les rivieres Caniapiscau et Koksoak en conditions naturelles, volume 2: stations-temoins: points de repere et courbes granulometriques** * Les Consultants SOGEAM inc, Montreal, Que * 1982-04.

Le present rapport couvre les resultats de l'etude geomorphologique realisee prealablement a la reduction des debits prevue dans la realisation du detournement des eaux du bassin superieur de la riviere Caniapiscau vers La Grande riviere dans le cadre de l'Amenagement hydroelectrique du complexe La Grande phase 1. Les resultats concernent le corridor fluvial delimite par la canyon Eaton sur la riviere Caniapiscau et l'ile Koksoak sur la riviere Koksoak, soit une longueur de 338 km. L'etude s'inscrit dans un programme de surveillance visant a cerner la nature et l'ampleur des modifications et a valider certaines mesures de correction possibles. Ce rapport est le deuxieme d'une serie de trois. Il fournit les profils des stations-temoins, le schema des points de repere et les courbes granulometriques qui ont ete elaborees dans cette etude.

F10603
DIR DE L'ENVIRON, LES CONSULTANTS SOGEAM INC * **Etablissement et caracterisation de stations-temoins (geomorphologie) sur les rivieres Caniapiscau et Koksoak en conditions naturelles, volume 1: textes et tableaux, documents cartographiques** * 108p * Les consultants SOGEAM inc, Montreal, Que * 1982-02.

Le present rapport couvre les resultats de l'etude geomorphologique realisee prealablement a la reduction des debits prevue dans la realisation du detournement des eaux du bassin superieur de la riviere Caniapiscau vers La Grande riviere dans le cadre de l'amenagement hydroelectrique du complexe La Grande phase 1. Ce rapport concerne le corridor fluvial delimite par le canyon Eaton sur la riviere Caniapiscau et l'ile Koksoak sur la riviere Koksoak, soit une longueur de 338 km. L'etude s'inscrit dans un programme de surveillance visant a cerner la nature et l'ampleur des modifications et a valider certaines mesures de correction possibles. Ce premier volume d'une serie de trois, contient les textes, tableaux et cartes, se rapportant aux observations de terrain, resultats d'analyses et de donnees cartographiques. Les grandes lignes du rapport et les principales conclusions de l'etude sont resumees en debut de volume.

066735
GIBB JE, MCMULLIN KA * **Regional water resources Pictou County Nova Scotia** * 81p * NS Dep Environ, Water Plan Manage Div * 1980.

This study evaluates the occurrence, quality and quantity of surface and groundwater in Pictou County, Nova Scotia and assesses the probability of contamination of water resources from human activities and advises on measures to alleviate such problems. Three major river basins were studied: the West River; the Middle River; and the East River. Surface water quality was generally found to be satisfactory with the exception of possible turbidity problems after storms and high dissolved solids during very low flow on the West River. Groundwater aquifers in the County were analyzed for flow rates and water quality. Water quality was generally good except for instances of high iron and manganese. Water supply options for the four towns of Stellarton, Westville, New Glasgow and Trenton are presented as well as recommendations for increasing the water supply to the Town of Pictou.

065253
GILLIES R, LAKSHMAN G * **The water budget of shallow, permanent or intermittent natural reservoirs as it affects economy and wildlife, a compilation of hydrometeorological data collected from sloughs from 1971 to 1975, Progress Report No. 8** * 52p * Sask Res Counc, Saskatoon, Sask * 1978-03.

Field data were collected from selected sloughs in Saskatchewan from 1964 to 1975. Data collected from 1971 to 1975 are presented in this report. Earlier data are contained in the Saskatchewan Research Council Report E71-12. Rainfall records, windspeeds, water temperatures, air temperatures, humidity, waterloss, water table elevations, and water surface elevations are included in this report. The instrumentation used to obtain the data is briefly described.

065007
HARRIS HJ, TALHEIM DR, MAGNUSON JJ, FORBES AM (ED) * **Green Bay in the future - a rehabilitative prospectus** * Tech Rep No 38 * 59p * Great Lakes Fish Comm, 1451 Green Road, Ann Arbor, MI 48105 US * 1982-09.

Three workshops were held to assess the most critical stresses affecting the ecosystem of Green Bay in Lake Michigan and to define technical, socioeconomic, and institutional aspects of rehabilitation. Analysis of these factors, based on matrix construction and graph theory, indicated that for Green Bay the most significant stresses involved nutrients, suspended solids and sediments, toxic substances and the fishery. The outcome of the planning effort is an ecosystem-oriented

management plan that recommends specific strategies dealing with critical biological and physical stresses affecting the bay. The plan addresses marginal costs and benefits of rehabilitation strategies and identifies the need for institutional arrangements for implementing the plan within the existing local, state and federal frameworks. Management priorities for the rehabilitation plan include: reducing nutrients and suspended solids, minimizing wind stress and resuspension of bottom sediments, curtailing carp populations, and decreasing toxic substances in the ecosystem. The results would be an improvement in water quality and in the fishery and recreational potential of the bay.

066025
HUDSON RF, CARTER CD * **Preliminary water resources study Southwestern Nova Scotia** * NS Dep Environ Water Plann Manage Div Rep 80-3 * 69p * NS Dep Environ, Halifax, NS * 1980.

One of the objectives of this study was to locate and evaluate potential groundwater or surface water supplies, which are so situated that they would be of benefit to the fish processing industry, and to make recommendations for their development, protection and management. The study was also undertaken to develop a database on a regional basis and provide a foundation for its continuing expansion and refinement. This area of the Province has been plagued by serious water shortage problems especially within the fish processing industry. Attention was focused on locating and identifying sand and gravel deposits, test drilling and aquifer testing and water budget calculations. The geology and water quality are discussed in this report.

064831
JACK ME * **Baseline study of the watershed near Venus mine, Yukon and Venus mill, British Columbia** * Reg Program Rep No: 81-18 * 80p * Environ Prot Serv, Pac Reg, Yukon Branch, Environ Can * 1981-10.

A baseline study was undertaken by the Environmental Protection Service of the watershed near Venus mine (site of a former mining and milling operation) in the Yukon, and Venus mill in British Columbia in 1980 before their planned development and start of operation in June 1981. Water quality parameters, bottom fauna characteristics and sediment quality were documented and evaluated at twenty-three sampling stations. The environmental quality of the unaltered part of the watershed was similar to other unaltered lakes and creeks in the Yukon River Basin. The environmental quality near the abandoned tailings pond continues to be adversely affected by this part of the operation. Significantly higher concentrations of cadmium, lead and zinc were found in sediment samples in the lake near the abandoned tailings, pond than in sediment samples from unaltered parts of the watershed. Arsenic concentrations in abandoned tailings pond drainage and mine water were significantly higher than those in water in the unaltered part of the watershed.

065705
JACK ME, OSLER TR * **Baseline study of the watershed in the Silver Tusk area, Yukon Territory** * Reg Program Rep 82-18 * 58p * Environ Can, Environ Prot Serv * 1982-10.

A predevelopment study was undertaken by the Environmental Protection Service of the watershed near Silver Tusk Mines Ltd. in June, 1981. Except for the mine adit water which had high concentrations of dissolved salts, water quality met drinking water criteria. The sediment metals concentrations were similar to other Yukon streams except at the mine adit where high concentrations of metals reflected those present in Silver Tusk ore. The bottom fauna results were representative of clear, unpolluted, Yukon streams. The presence of trace amounts of antimony, cadmium, copper, and mercury in the ore will have to be considered in planning minewater and mill effluent treatments when Silver Tusk Mine is developed, because concentrations of these metals will have to be kept low in effluents.

062260
KADLEC JA * **Water budgets for small diked marshes** (see chapter 4.9 for complete reference - voir chapitre 4.9 pour la reference complete)

063379
KEREKES J, SCHWINGHAMER P, SCOTT R * **Aquatic resources inventory, Cape Breton Highlands National Park, Nova Scotia, Part 4, Selected limnological measurements in streams, lake inlets and outlets** * 57p * Can Wildl Serv, Atl Reg * 1980.

Limnological measurements obtained between April 1976, and December 1977, from 30 streams, 19 lake inlets and 15 lake outlets in Cape Breton Highlands National Park, Nova Scotia, are presented.

063378
KOOYMAN AH * **The aquatic resources of Riding Mountain National Park, Volume VIII: Photographs of lakes, ponds and streams** * vp * Can Wildl Serv, Winnipeg, Man * 1981.

The photographs in this album provide a record of the visual appearance of each lake, pond or stream from a given vantage point at a moment in time. Seasonal and annual variability may be revealed when more than one photograph of a water body is presented. These photographs will give the viewer an appreciation of the diversity of aquatic habitats in Riding Mountain National Park.

Limnological data on these waters have been tabulated in the following volumes of this report: Volume I - General Summary, Volume II - Aquatic macrophytes and macroinvertebrates, Volume III - Data on lakes, Volume IV - Data on ponds, Volume V - Data on streams, Volume VI - Data on wetlands, and Volume VII - Atlas: Aquatic Resources of Riding Mountain National Park.

063398
KWIATKOWSKI RE, NEILSON MAT * **Lake Ontario surveillance data, 1968-1980** * Tech Bull No 126 * 69p * Inland Waters Div, Water Qual Branch, Environ Can, Ottawa, Ont * 1983.

According to the Great Lakes International Surveillance Programme designed by the International Joint Commission, 1981 and 1982 are scheduled as intensive years for Lake Ontario. Since 1968 annual cruises have been conducted on Lake Ontario by the federal Department of the Environment's research centre, the Canada Centre for Inland Waters, to measure a variety of physical, chemical and biological parameters. The present report identifies the station locations, sampling frequency and parameter lists for the large lake cruises conducted between 1968 and 1980 in support of the Surveillance Programme. Whole lake im volume-weighted values for temperature, dissolved oxygen, specific conductance, total phosphorus, soluble reactive silica, and corrected chlorophyll a are given by cruise for the years 1968 to 1980.

064733
LAKE SYST UNIT, WATER MODEL SECT, ONT MINIST ENVIRON * **Hamilton Harbour study, volume 1** * vp * Ont Minist Environ, Toronto, Ont * 1981-03.

Hamilton Harbour is a natural harbour located at the western corner of Lake Ontario. This report discusses the results of the 1976-77 current meter operations in the harbour, Burlington and Desjardins Canals, including lake-harbour and harbour-Cootes Paradise exchange and the physical processes responsible for the currents and is a continuation of the series of reports on Hamilton Harbour physical data. The currents at the mid-harbour location during 1976-77 were similar to those observed during 1975. All data collected were numerically smoothed and then partitioned into monthly data sets. Statistical analyses of water movements and temperatures were performed to determine the spatial and temporal characteristics. Currents at the Burlington Canal locations were examined to compute the lake harbour exchange using the excursion episode method. Estimates of the flow through Desjardins Canal were made using average currents and the approximate cross-sectional area of the canal.

F11594
LAPOINTE D * **Eaux de surface, bassin versant de la Chateauguay** * Rapp E.F.-1 * 78p * Minist richesses nat du Que * 1980.

Le but de cet ouvrage est de constituer un dossier hydrometrique du bassin versant de la riviere Chateauguay et de ses principaux tributaires. Le dossier est presente en deux volets: la premiere partie dresse l'inventaire des installations hydrometriques dans le bassin versant de la riviere. Sont fournies egalement les caracteristiques hydrologiques de l'ensemble du bassin. La seconde partie detaille pour chaque station, les parametres hydrologiques tel les debits annuels, saisonniers, mensuels et journaliers en plus des analyses statistiques sur le regime des cours d'eau permettant de faire ainsi des projections.

065861
MACLAREN ENGINEERS, PLANNERS AND SCIENTISTS INC, GUARDIAN BUILDING SUITE 608, 10240-124TH STREET, EDMONTON, ALTA T5N 3W6 * **Paddle River dam site development, water resources management study, appendix H** . IN: Paddle River Dam, environmental impact assessment * v3 52p * Alta Environ, Plann Div * 1981-11.

This report interprets the water resources management functions, operational conditions and design considerations of the Paddle River Reservoir and their implications on recreational development. Pertinent water data is included on: precipitation, evaporation; river flow and flood frequency; reservoir elevation, capacity and flooded area; reservoir operation; tailwater elevation; current downstream water demand; possible water demands; groundwater and drainage; water quality; water temperatures; ice thickness; sedimentation; soil conditions and wind action. Horizontal fluctuation of the water edge or shoreline is a major concern in this study. It has a significant effect on potential recreational activities such as swimming, boating and picknicking. Reservoir recreational development is recommended only in areas within 3000 m (9840 ft) upstream of the dam and at elevation above 1:100 year flood level of 706.9 m (2318.6 ft). Drawdown of water level below the permanent pool elevation is normally not expected. Only a slight drop in water level may occur in a dry year.

062304
MANITOBA DEP NAT RESOUR, WATER RESOUR BRANCH, HYDROL SECT * **Surface water data 1980** * vp * Manitoba Dep Nat Resour, Water Resour Branch, Hydrol Sect * 1982-11.

This report summarizes surface water data collected by the Province of Manitoba, Water Resources Branch during the 1980 calendar year. Data was collected at 96 hydrometric stations. The data is the accumulation of water levels and discharge measurements

obtained for flood forecasting, reservoir regulation and specific surface water investigations. A map showing the distribution of the stations and their approximate location is included in the report. Each hydrometric station is identified by a station reference number. The station numbering system adopted is the same as that used by Water Survey of Canada. The first two numbers identify the major drainage basin in which the station is located and the next two characters indicate the sub-basin and the last three digits the station number. To avoid duplication of Water Survey of Canada numbers, all Manitoba Water Resources Branch station numbers start with an eight. A numerical index of the station numbers is included with the map. Appendix A contains water level readings obtained at the 96 hydrometric stations. The data is arranged in alphabetical order of the station name. An alphabetical index of the station names is contained at the beginning of the Appendix. The 1980 water levels are presented both in graphical and tabular form. For manually operated stations, levels are actually instantaneous observations, but they are assumed to represent the mean level for the day. At stations located at a dam with a fixed crest spillway a single dashed line was drawn on the hydrograph to present the elevation of the spillway crest. At stations located at a stoplog dam, two dashed lines were drawn on the hydrograph. These lines represent the upper and lower elevations of the desired operating range of the lake or reservoir. Miscellaneous discharge measurements obtained by the Water Resources Branch in 1980 are contained in Appendix B.

065313
MARIT RESOUR MANAGE SERV * **Nova Scotia watersheds** * vp * Marit Resour Manage Serv, PO Box 310, Amherst, NS B4H 3Z5 * 1982.

This report contains an index of the watersheds of the province of Nova Scotia which is presented in tabular form. The index was patterned after the system used by the Water Resources Branch of the Water Survey of Canada. The watersheds of the province were divided into three groups: all mainland watersheds draining into either the Bay of Fundy or the Northumberland Strait, all mainland watersheds draining into the Atlantic Ocean, and all watersheds on Cape Breton Island. Each of these groups was further subdivided. Both the land and water area of each watershed was measured in hectares.

F11556
MARTINI IP (ED) * **Recueil de travaux presentes au symposium sur la baie d'Hudson et la baie James, Universite de Guelph, Guelph, Ontario, Canada, 28-30 avril 1981** * Nat can * 2v 301-1019 * 1982-12.

Soixante papiers furent presentes au Symposium sur la baie d'Hudson et la baie James qui eut lieu a l'Universite de Guelph, Guelph, Ontario, du 28 au 30 avril 1981. Ce symposium avait trois objectifs: d'exposer la recherche actuelle en cours dans la baie et ses alentours; d'encourager les discussions entre les scientistes de differentes disciplines; de determiner le besoin d'autres recherches dans cette region. Les papiers ont ete divises en dix sections afin d'illuster la formation de la baie James-Hudson, son evolution, la colonization de terre par les plantes, les conditions oceanographiques et l'usage que la faune et l'homme font de ses ecosystemes. Le premier volume traite de la geologie et geomorphologie, de la climatologie et pergelisol, des sols, de la vegetation ainsi que de la cartographie et classification des terres. Le deuxieme volume decrit l'oceanographie physique, l'ecologie marine, l'impact ecologique des amenagements hydroelectriques, de la biologie de la faune ainsi que de l'ecologie humaine.

065791
MATHER JC * **Relationship between stormwater management and watershed management** (see chapter 4.3 for complete reference - voir chapitre 4.3 pour la reference complete)

F11642
MESSIER D * **Liste des rapports** * 16p * Groupe d'etude conjoint Canipiscau-Koksoak, Soc energie de la Baie James, Montreal, Que * 1983-04.

Ce document rassemble les rapports relatifs a l'etude de la region Caniapiscau-Koksoak et aux Melezes, effectues par ou pour le Groupe d'etude conjoint Caniapiscau-Koksoak de la Societe d'energie de la Baie James. Ces rapports sont regroupes sous trois rubriques: 1) liste des rapports presentes au Groupe d'etude et a la direction Environnement de la Societe d'energie de la Baie James 2) liste des rapports se rapportant aux etudes effectuees apres la coupure de la riviere Caniapiscau 3) liste thematique des rapports: milieu physique, ichtyofaune et potentiel piscicole, populations de saumons, vegetation, faune terrestre et faune avienne, etudes generales et syntheses.

064750
MINIST ENVIRON, WATER RES BRANCH * **Water resources of the Holland and Black River basins - Summary** * Water Res Rep 15 * vp * Minist Environ, Water Res Branch, Toronto, Ont * 1982.

Interest in the further development of water resources for various uses in the Holland and Black river basins has prompted the preparation of this comprehensive inventory study of the quality and availability of surface and ground waters in the area. The report deals with the

occurrence, distribution, quantity, quality and use of surface and ground waters. It addresses general hydrologic conditions in the study area. Topics are presented as maps, graphs and tables, with accompanying explanatory notes, on a set of seven sheets: climate and physical setting; locations of selected water wells and logs of test holes; availability of ground water; quality of ground water; surface-water hydrology; quality of surface waters, 1977; water resources management.

066762
MONTREAL ENG CO LTD • **Lake Major watershed management study** • 3v 399p • Montreal Eng Co Ltd, Halifax, NS • 1980-02.

Lake Major is situated north of the city of Dartmouth, Nova Scotia. This report presents the findings and recommendations of a study into the development of a comprehensive management plan for the Lake Major watershed. The report is contained in three volumes. Volume 1 contains an executive summary; Volume 2 identifies the characteristics of the watershed area and Volume 3 outlines the management options available. The study identifies and attempts to reconcile the present and potential conflicts between use of the watershed as a water supply area, and the aspirations of the communities located in or adjacent to the watershed boundaries. The studies have shown that the communities are presently having little impact on water quality in either Long Lake or Lake Major but that there is a potential for increased microbiological contamination. Provided that measures are taken to control domestic wastes in North Preston and the community of Lake Major, and a major effort is made to control wastes from piggery operations in North Preston, it is thought that the present level of activity in the communities and the use of the area for water supply is compatible. The remainder of the watershed is of some concern because the area is presently not covered under a county plan. It is recommended that the watershed outside the area covered under the proposed community development plans be designated as a "Protected Water Area" under the Water Act. In this manner, a satisfactory degree of control over present and potential activities in the watershed can be achieved. Under this designation option a number of management options have been considered and it is concluded that a committee modelled after the present Lake Major Watershed Working Committee be established to act in an advisory capacity. To meet the "objective" limits of the Canadian Drinking Water Standards and Objectives (1968) it is concluded that a water treatment plant would be required to treat the water withdrawn from Lake Major. This treatment is required because of the natural water quality.

062383
NIIMI AJ • **Economic and environmental issues of the proposed extension of the winter navigation season and improvements on the Great Lakes St. Lawrence Seaway system** • J Great Lakes Res • 8(3) 532-549 • 1982.

The Governments of the United States and Canada must decide in the near future if vessel and cargo transit on the Great Lakes-St. Lawrence Seaway (GL-SLS) is to be operated at capacity or the system be improved to accommodate the projected increases. Portions of the GL-SLS could approach operating capacity in the mid-1980s and options to increase capacity include extending the present 8 1/2 month navigation season to 11-12 months, and/or upgrading existing facilities to accommodate larger vessels. The U.S. Army Corps of Engineers is one of the few groups which has examined this issue in depth, and has concluded that it is technically and economically feasible to increase the capacity. The economic and environmental issues of the Corps proposal are discussed as viewed from a Canadian perspective. Total cost of the proposed improvements is difficult to establish because some economic costs and benefits can be identified while others are less obvious, and environmental costs and benefits have not been adequately assessed to provide the basis for a rational judgement. The major economic and environmental concerns are discussed to demonstrate the need for more information that would be required by both countries to make an equitable decision. An evaluation of the proposed improvements to the GL-SLS on the environmental resources of Canada is presented. Environmentally sensitive areas such as shorelines, wetlands, and inshore and shallow areas along the interconnecting waterways have been characterised and it is evident that a large percentage of these areas occur within Canadian waters. Furthermore, most of the major capital improvements proposed for the system are in Canada. In view of this, it is suggested that the cost-sharing arrangement between the U.S. and Canada proposed by the Corps of Engineers for improvements on the GL-SLS would not be in the best interest of Canada.

062346
OKANAGAN BASIN IMPLEMENTATION BOARD • **Summary report on the Okanagan Basin Implementation Agreement** • 34p • Okanagan Basin Implementation Board and BC Minist Environ • 1982-09.

This report highlights the results reported on in the Report on the Okanagan Basin Implementation Agreement. Highlights of the plan review relating to economic growth, water, water quality, demand for sport fishing and the demand for water based recreation are presented. A statement is made on public preferences and attitudes on water management in 1981. Twenty-five recommendations are

presented for ongoing management relating to water quantity, water quality, fisheries and water-bases recreation in the Okanagan Basin. Recommendations are also made regarding the coordination and management of the plan.

064357
OKANAGAN BASIN IMPLEMENTATION BOARD * **Report on the Okanagan Basin Implementation Agreement** * 126p * Environ Can and BC Minist Environ * 1982-09.

This report sets out the implemented comprehensive framework plan for the development and management of water resources in the Okanagan River Basin, a five-year agreement signed by Canada and British Columbia on February 9, 1976. Significant changes since 1970 which have affected the method and manner of implementation, anticipated trends in demands and use over the next ten years, and a statement of public expectations and continuing concerns, are outlined. The report also addresses ongoing actions for water resource management that are considered necessary to maintain acceptable levels of environmental quality, economic viability and social betterment, given the rapidly increasing population and changing social and economic expectations. Recommendations for the ongoing management of this resource over the next decade are presented. This includes basic recommendations, and detailed recommendations on the water quantity, water quality, fisheries, and water-based recreation components, with implementation measures recommended and actions taken.

F11826
PARCS CAN * **Les rivieres sauvages: Terre-Neuve et Labrador** * Les rivieres sauvages * 64p * Parcs Can * 1977.

Les rivieres sauvages constituent des tresors inestimables de notre patrimoine naturel. Les rivieres sauvages de Terre-Neuve et du Labrador decrites dans ce livre comprennent: la riviere du Petit-Mecatina, la riviere Ugjoktok, la riviere Kanairiktok, la riviere Naskaupi, la riviere des Dies, la riviere Humber, les rivieres Lloyds et des Exploits et la riviere Main. Chaque riviere constitue un chapitre dans lequel sont decrit la geographic, la faune, la flore, l'historique et l'excursion en canot. Une carte de chaque riviere est inclue en debut de chapitre

F11827
PARCS CAN * **Les rivieres sauvages: montagnes du Nord-Ouest** * Les rivieres sauvages * 96p * Parcs Can * 1980.

Il reste tres peu de grandes rivieres au Canada ou l'on peut faire du canot, des sources jusqu'a l'embouchure, sans apercevoir les vestiges du passage de l'homme. Les rivieres du Nord-Ouest, auxquelles on ne peut acceder bien souvent que par la voie des airs, permettent aux canoteurs de vivre une experience de plus en plus rare. Les rivieres sauvages des montagnes du Nord-Ouest decrites dans cette brochure comprennent: les rivieres Mountain, Natla, Keele, Restone-Sud, Frances, Liard, Stikine, Dease, Gataga, Kechika, Ogilvie, Peel, Plume-du-Bonnet et Firth. Chaque riviere constitue un chapitre dans lequel sont decrit la geographie, la faune, la flore, l'historique et l'excursion en canot. Une carte de chaque riviere est inclue en debut de chapitre.

F11768
PARE D * **Etude hydrogeologique du bassin de la riviere du Nord** * E.D.4 * 44p * Minist richesses nat du Que, Dir gen des eaux, Quebec, Que * 1980.

Cette etude s'inscrit dans le cadre du programme de connaissances integrees mis de l'avant par le ministere des Richesses naturelles du Quebec. Le but de l'etude est d'identifier les nappes aquiferes deja exploitees ou reconnues du bassin de la riviere du Nord dans la region de Montreal. Toutes les municipalites du bassin ont ete visitees afin de recueillir des renseignements sur les puits d'essais et de production; A egalement ete consulte la banque de donnees hydrogeologiques du ministere; l'etude a ete completee par le prelevement d'echantillons d'eau pour fin d'analyses chimiques et la visite d'autres points d'interet hydrogeologiques tels sources, gravieres et carrieres ou la nappe d'eau est mise a jour. Le present document comporte en annexe une carte hydrogeologique et des tableaux ou sont illustres et compiles tous les renseignements recueillis au cours de l'inventaire. La carte en pochette comprend egalement la geologie des depots meubles regroupes selon la permeabilite et la geologie de la roche en place.

F11769
PARE D * **Etude hydrogeologique du bassin de l'Assomption** * E.C.3 * 77p * Minist richesses nat du Que, Dir gen des eaux, Quebec, Que * 1980.

Cette etude s'inscrit dans le cadre du programme de connaissances integrees mis de l'avant par le ministere des Richesses naturelles du Quebec. Le but de l'etude est d'identifier les nappes aquiferes deja exploitees ou reconnues du bassin versant de la riviere l'Assomption pres de Montreal. Toutes les municipalites du bassin ont ete visitees afin de recueillir des renseignements sur les puits d'essais et de production; a egalement ete consultee la banque de donnees hydrogeologiques du ministere; l'etude a ete completee par le prelevement d'echantillons d'eau pour fin d'analyses chimiques et la visite d'autres points d'interet hydrogeologique tels sources, gravieres et

carrieres ou la nappe d'eau est mise a jour. Le present document comporte en annexe une carte hydrogeologique et des tableaux ou sont illustres et compiles tous les renseignements recueillis au cours de l'inventaire. La carte en pochette comprend egalement la geologie des depots meubles regroupes selon la permeabilite et la geologie de la roche en place.

062255
PLANN SERV BRANCH, PLANN DIV, ALBERTA ENVIRON * **Nose Creek water management study, environmental overview** * 53p * Alberta Environ, Environ Eng, Plann Serv Branch, Plann Div * 1980-08.

This report is one of several to develop guidelines for future water management in the Nose Creek and West Nose Creek Basins. This report examines land use, water use, and environmental values. It is intended to provide general information on the existing environment of the creeks and surrounding areas, some of the changes likely to occur in the near future, some of the more obvious relationships between the environment and water management practices, and some possible ways of preserving and enhancing the creek and valley environment. In the recommendations made within the report, factors of cost, jurisdiction, and engineering feasibility have not been considered. As well, since this report has been completed early on in the overall study, important information on hydrology and water quality was not available. Thus the recommendations are proposed as suggestions that should be assessed during the more detailed work in this study, rather than specific proposals that should be implemented. The information for this report came from published and unpublished reports and mapping, government data bases, discussions with government employees, air photo interpretation, and some field work. The aerial photographs were black and white panchromatic stereo photographs, taken October 8, 1979 at a scale of 1:10,000. Field work consisted of two short visits, one in November, 1979 and one in February, 1980. This study area consists of Nose Creek from its confluence with the Bow River to approximately 4 kilometres north of Airdrie, and West Nose Creek from its confluence with Nose Creek about 8 kilometres west. The study was restricted to the land within the valley breaks. To aid in analysis the study area was divided into twelve reaches, each having relatively distinctive natural and cultural characteristics. It should be noted that the creek referred to in this report as West Nose Creek is generally known as Beddington Creek and in virtually all of our source documents and data bases is referred to as such. Beddington Creek is actually a smaller tributary of Nose Creek that enters the creek approximately one kilometre north of the Nose-West Nose confluence.

066734
PORTER RJ * **Regional water resources Southwestern Nova Scotia** * 87p * NS Dep Environ * 1982.

This report of the Southwestern Nova Scotia Water Resources Evaluation Project locates sources of water and examines the quantity and quality to satisfy the demands of municipalities and industry, primarily fish plants. The study area consists of Shelburne County, Yarmouth County, and the Municipality of Clare in Digby County. Results indicate that sufficient quantities of surface water with some treatment are available to satisfy present and expected future municipal and industrial demands in the area. Groundwater is found mainly in slate and granitic-type rocks and therefore quantity is dependent on fracture flow. Yields are typically sufficient for normal household use and in most cases do not require treatment. Recommendations to overcome shortage on Cape Sable Island are made.

063279
PRINCIC R * **Economic analysis of dyke improvement for Westham and Reifel Islands** * 25p * Environ Can, Environ Conserv, Inland Waters Dir, Pac Yukon Reg, Vancouver, BC * 1982-11.

The objective of this study is to examine the economic feasibility of upgrading the dykes of Westham and Reifel Islands to Fraser River Project standards (200 year return flood). Economic analysis is carried out for a dyke alignment incorporating both Westham and Reifel Islands, a dyke around Westham Island only and a dyke around Reifel Island only. In spite of the difficulties of trying to assess flood control benefits for this area, the study does provide a good indication of the order of magnitude of benefits on the islands. It shows that the project as presently conceived is not economically feasible and that further refinement is not likely to lead to significant changes in the results. Although dykes up to full Fraser River program standard were found to be uneconomic, this does not rule out the possibility that some lower standard may be justified. Since it is safe to assume that this area will continue to be protected, in part, because of the Migratory Birds Treaty and other considerations outlined in the report, ongoing maintenance will be required. It is possible that a lower dyke standard may prove to be cheaper, in the long run, than haphazard maintenance and occasional damages.

065157
PSUTKA MM, HARVIE BW * **Physical description of selected tributary mouths and sheltered backwaters of the Athabasca and Clearwater Rivers** * 105p * Alta Environ, 15th Floor, Oxbridge Place, 9820-106 St, Edmonton, Alta T5K 2J6 * 1980-07.

A survey of the physical characteristics of the aquatic habitats at 25 locations on the Athabasca and Clearwater rivers was conducted during August 1978. The parameters determined at each site were current velocity and direction, depth, Secchi disc visibility, substrate composition, and temperature. The survey sites included sheltered areas downstream of points of land or islands, as well as tributary confluences. Downstream of points of land or islands, current velocity and flow direction were altered markedly and substrates were typically sands or silts. Physical changes evident at tributary confluences were Secchi visibility, current velocity, and flow direction. At the tributary mouths, sand and silt substrates were predominant in sheltered areas of low current velocity while coarser rock substrates occurred in otner areas of the confluences.

064155
REG ECON EXPANS, PRAIRIE FARM REHABIL ADM, ENG SERV, ALBERTA REG DIV * **Engineering report, Milk River basin study (1980)** * 26p * Reg Econ Expans, Prairie Farm Rehabil Adm, Eng Serv, Alberta Reg Div, Calgary, Alta * 1980-07.

This report presents hydrologic assessments, preliminary structure layouts and cost estimates relative to proposed on-stream storage dams and reservoirs on the Milk River at Site 2 and on the North Milk River at Site 2 and to works capable of diverting a portion of the Milk River flows into an off-stream storage reservoir at Verdigris Lake. The study is a follow-up and extension of the July 1978 Engineering Study. The storage capacities, flooded areas and estimated project costs over a range of firm annual drafts for the projects investigated are given. Detailed reservoir topographic maps were prepared by photogrammetric methods for Milk River Site 2, North Fork Site 2 and three sites studied in 1978 but not described in this report. As a result of the new mapping, the 1978 storage-area-elevation curves have been revised to conform to the new data and these have modified the firm annual drafts of the projects studied in 1978. Preliminary studies of the feasibility of installing hydro-electric power generating facilities in the High Level dam at Milk River Site 2 indicate that an average of 15.7 kwh of power could be generated annually. The cost of constructing the complete generating facilities for immediate power production is estimated at $9.6 million in addition to the $23.9 million indicated above. If power development is deferred but a penstock valve is installed during construction of the works to convey water to a future powerhouse, $0.7 million has to be added to the cost of the High Level dam.

065864
REID, CROWTHER & PARTNERS LTD, HYDROCON ENGINEERING LTD * **Paddle River dam environmental impact assessment, hydrology, Appendix I** , IN: Paddle River Dam, environmental impact assessment * v3 50p * Alta Environ, Plann Div * 1981-11.

The purpose of this report is to describe hydrological conditions of the Upper Paddle River system in the vicinity of Site 7B, and to discuss potential changes to the hydrology, water quality and groundwater regimes resulting from the impoundment of the Paddle River by a dam at Site 7B. The perceived impacts of the projects are then used to identify procedures which may be implemented to monitor any programs associated with the introduction of mitigation measures. Potential environmental impact on flows and river channels are described under: construction and immediate post-construction; reservoir operation during floods; and, reservoir operation during non-flood periods. Impacts are tables on non-flood uses such as water-based recreation, fisheries, water supply, flow augmentation, sewage dilution and power generation. The effect of the dam on the water quality in the Paddle River are based on the following factors: flow regime, temperature, dissolved oxygen, level fluctuations, sedimentation, nutrients, aquatic plants and macro-invertebrates. The expected or projected changes in these water quality factors have been examined for both the reservoir and river downstream of the dam.

F10598
ROCHE ASSOC LIMITEE * **Etude des ecosystemes aquatiques et terrestres de la region du futur reservoir de EM 1, synthese des etudes** * 127p * Roche assoc limitee, Sainte-Foy, Que * 1982-04.

La realisation du projet EM 1 dans le cadre de l'amenagement hydroelectrique du complexe La Grande implique des changements physiques qui, modifiant le milieu et les habitats aquatiques, affectent tous les elements de la chaine trophique. La presente etude consiste d'une part a realiser la synthese des differentes caracteristiques biophysiques des ecosystemes aquatiques existant a l'etat naturel et, d'autre part, a evaluer les repercussions de la creation du reservoir de EM-1 sur la qualite des eaux et sur la faune aquatique. Les elements du milieu aquatique sont consideres en trois volets, soit la qualite de l'eau, le plancton et le benthos et enfin, la faune piscicole. Pour chacune de ces sections, les resultats obtenus dans la region de EM-1 sont compares avec ceux des milieux aquatiques des regions adjacentes (LG 2, Opinaca, NBR) quand ceux-ci sont disponibles et compatibles.

F10471
ROUY D, FAUBERT N * **Etudes limnobiotiques complementaires sur les rivieres Caniapiscau et Koksoak** * pd * Groupe d'etude conjoint Caniapiscau-Koksoak, Soc energie de la Baie James, Montreal, Que * 1981-12.

Ce cahier contient deux rapports: le premier porte sur l'inventaire des poissons du lac Cambrien; il presente en plus du materiel et des methodes de travail utilises, les resultats et une discussion sur les mesures physico-chimiques de l'eau et les rendements de peche de la campagne de juillet 1981 au lac Cambrien. Le second rapport sur l'etude de l'ichtyofaune du troncon superieur de la riviere Koksoak, en plus de decrire le milieu physique (geomorphologie et hydrographie), poursuit les memes objectifs que le premier ouvrage sur le fleuve Koksoak cependant, du point d'origine a la limite d'influence de la maree.

067098
SHERWOOD DE * **The Similkameen River basin, an overview of water and related resources** * 61p * Inland Waters Dir, Pac Yukon Reg, Environ Conserv, Environ Can, Vancouver, BC * 1983-02.

The Similkameen River drains approximately 7600 square kilometres of British Columbia's southwestern interior. Rising in the Cascade Mountains, the river flows over 200 kilometres in a gentle arc from its source to its confluence with the Okanogan River in Washington State. The upper reaches of the river are fast flowing and valley walls are precipitous; in the lower reaches from Keremeos to the international border the valley widens and flattens. Climatic conditions and arable soils in the lower valley are favourable for agriculture--tree fruits, vegetables, and, increasingly, grapes are significant contributors to the economy. However, forestry and mining are the major industries in the Basin, both by employment and value of production. Due to present market conditions, future expansion in the Basin appears limited to the mining sector. Water resource issues relate to flood control, water supply for irrigation, creation of an anadromous fishery, and water quality concerns from industrial and municipal discharges. Since the Similkameen is an international river, the Inland Waters Directorate may become involved in future water resource management.

F11853
SOC CAN GENIE CIV * **5e Conference canadienne d'hydrotechnique, comptes-rendus, 26 & 27 mai 1981, Fredericton, NB** * 2V 977p * Soc can genie civ * 1981-05.

On presente les comptes-rendus de la 5e Conference canadienne d'hydrotechnique qui eu lieu les 26 et 27 mai 1981, a Fredericton, Nouveau-Brunswick. Les exposes traitaient de l'afouillement local, de processus littoraux, de la qualite de l'eau de reservoirs et de rivieres, de glaces dans les rivieres, des structures de raccordement entre les barrages en terre et d'autres ouvrages, de modeles hydrauliques (physiques), des problemes hydrotechniques dans l'environnement urbain, des etudes de dessins pour problemes hydrotechniques, de l'ecoulement irregulier dans des canaux ouverts ainsi que de sujets speciaux en ingenierie hydrotechnique.

065701
SOROKA I, JACK ME * **Baseline study of the watershed near proposed Marbaco Mine, B.C. and Marbaco Mill, Yukon Territory** * Reg Program Rep 82-06 * 63p * Environ Can, Environ Prot Serv * 1982-04.

A baseline study of the watershed near the proposed Marbaco Mine in northwestern British Columbia and proposed Marbaco Mill in south-central Yukon was conducted by the Environmental Protection Service from June 24 to June 26, 1981. The water quality, bottom fauna characteristics and sediment quality of nine sampling stations were documented and evaluated. Generally, the water chemistry parameters in the Tootsee-Rancheria watersheds showed no unusual levels. The bottom fauna results were representative of generally clear, unpolluted mountain streams. The high silver (Ag), lead (Pb) and zinc (Zn) concentrations in the adit sediments reflected the presence of the mine ore body. The high arsenic (As), cadmium (Cd) and iron (Fe) concentrations in the adit sediments reflect the presence of gangue minerals associated with the mine ore body. When the proposed mine and mill go into operation, concentrations of arsenic and cadmium are of possible concern and treatment of effluents may be required to prevent environmental damage downstream.

064532
SOROKA IK, JACK ME * **Baseline study of the watersheds near the TOM property, MacMillan Pass, Yukon Territory** * Reg Program Rep No 83-14 * 73p * Environ Prot Serv, Pac Reg, Yukon Branch, Environ Can * 1983-07.

A predevelopment study was undertaken by the Environmental Protection Service in the watersheds near the TOM Property in MacMillan Pass, Yukon in July, 1981. The presence of ore minerals in the study area is reflected by their presence in water and sediment. All streams have soft water with low buffering capacity. With the exception of the South MacMillan River all sampling streams show very low natural pH levels and elevated metal concentrations that make them unsuitable for drinking water and aquatic life. This is probably why the numbers of bottom fauna collected were low. The metals of concern when a mine and mill become active will be arsenic, cadmium, copper, manganese, nickel, silver, lead and zinc.

061801
STEPHEN AP, HILL IK, CRONIN DLR * **Muskoka watershed management model** . IN: Proc 35th Annu Conf Canadian Water Resour Assoc on water-based recreation issues, conflicts, strategies, Minett, Ont, 1-4 June 1982 * WILLIAMS P * Can Water Resour J * 7(4) 96-125 * Can Water Resour Assoc, PO Box 250, Kingston, Ont K7L 4V8 * 1982.

The Muskoka River Basin in central Ontario covers an area of approximately 4,700 km. The water resources of this basin are important not only for year-round residents, but also for thousands of summer residents and tourists. Water resources management within the basin is complex. There are 34 control structures operated by four agencies, two locks for pleasure craft, 26 major lakes and nine hydro power stations operated by three utilities. Competing water use interests include recreation (including sportfishing), navigation, hydro power, flood control, and water supply. Significant efforts have been made by all interests to resolve possible conflict in water allocation. However, population and recreation pressures, rising energy costs, and sensitivity to fisheries and other environmental constraints, have increased pressure to further improve the basin management. The preparation of a major mathematical model of basin operations has been commissioned in order to review past policies in the allocation of water, and to improve floodhandling and other specific concerns. The model selected is a modification of the Trent River system operating model. It is now largely completed and undergoing testing and calibration. Major components of the background study include: physical data base compilation; historical basin operations description; model structure development; subbasin hydrologic modelling; and model calibration. These are described in the paper, along with sample results from hydrologic studies and basin simulation calibration. The present status of model development is explained, along with a description of the projected work program for the coming summer season. It is expected that by the end of 1982 model development will be completed to the extent that day-to-day operation of the basin can be performed according to model output instructions.

063338
THOMPSON RIVER BASIN PRE-PLANN TASK FORCE * **Thompson River Basin Pre-planning Task Force report** * 95p * Thompson River Basin Pre-plann Task Force * 1981-02.

This report of the Thompson River Basin Pre-Planning Task Force describes the quality and quantity of water resources of the basin and identifies the major water users and prospective developments which would have an impact on water. Background information on the basin is presented as well as the terms of reference of the study and the procedures used to conduct it. An overview is provided of the physical, biological and socio-economic environment of the basin. Past studies are examined as well as the existing water quality, hydrometric and meteorological networks in the basin. Water quality and water quantity concerns are identified from a basin-wide perspective and an indication is provided of available documented information. Concerns are identified which can best be addressed by existing administrative arrangements and a planning study is developed, including a description of component studies, their costs, and timing. The administrative process for a federal-provincial planning agreement is also presented. Finally, the conclusions and recommendations of the study are given.

F11909
TOWNSEND RD (ED) * **6e Conference canadienne d'hydrotechnique, comptes-rendus, 2 & 3 juin 1983, Ottawa, Ontario** * 2v 1039p * Soc can genie civ * 1983-06.

On presente les comptes-rendus de la 6e Conference canadienne d'hydrotechnique, qui eu lieu les 2 et 3 juin 1983, a Ottawa, Ontario. Les exposes traitaient d'hydrologie statistique, de structures hydrauliques, de l'hydraulique des canaux, d'etudes des debits de crues, d'etudes de l'environnement, de modeles physiques, du transport de sediments, des debits variables, et du genie des ressources hydrauliques. D'autres papiers concernaient la glace de mer, la canalisation, la degradation locale, le processus de sedimentation, les dissipateurs d'energie et la gestion des eaux d'orages. L'on decrivait egalement les processus cotier, la mecanique de glace ainsi que differents etudes de cas.

F11048
VAN COILLIE R, ST-ARNEAULT C * **Physico chimie aquatique des bassins hydrographiques au territoire Grande Baleine (1960-1979)** * EB-BIOP-ECO-80-6 * 78p * Eco-recherches inc, Que * 1981-11.

Lors des divers inventaires environnementaux faits au territoire Grande Baleine par et/ou pour l'Hydro-Quebec, des ministeres du gouvernement du Quebec et Environnement Canada, plusieurs donnees ont ete acquises sur la physico-chimie aquatique des bassins hydrographiques locaux. Ces donnees etant dispersees dans une vingtaine de rapports, un mandat de les regrouper dans un seul document a ete decide par l'Hydro-Quebec; cette demarche fait l'objet du present ouvrage. Le territoire a ete subdivise en trois entites hydrographiques, qui correspondent dans ce document a trois chapitres regroupant les valeurs enregistrees. Les resultats acquis lors des echantillonnages se rapportant a une trentaine de parametres, leur representation a ete simplifiee en 3 series de 10 parametres a savoir: les

parametres physico-chimiques generaux, les oligoelements et les elements traces.

065315
VAUGHAN JG, SOMERS GH * **Regional water resources Cumberland County, Nova Scotia** * 81p * NS Dep Environ * 1980.

The objectives of this study were to evaluate the occurrence, quality and quantity of surface and groundwater in Cumberland County. An assessment was also made of the probability of contamination of the water resources by human activities and to advise on measures to alleviate such problems. A hydrological investigation was conducted on the surface and groundwater resources of six major drainage basins located in Cumberland County. The study consisted of the collection and analysis of meteorological, hydrological and ecological data through the installation of seven meteorological recording stations and five streamflow recording stations. There were sixteen test wells drilled along with surficial mapping and both surface and groundwater sampling. Water potential and quality was examined for both groundwater and surface water. Forestry, agricultural feedlots, industrial and municipal sewage outfalls, solid waste disposal sites, and mining, including quarry and gravel pit operations, were surveyed to determine if any of them posed a serious threat to the water quality of the study area. The data is presented in ten separate volumes.

F10455
VEZINA, FORTIER ET ASSOC * **Bassin inferieur des rivieres Eastmain et Opinaca, etudes hydrologiques** * 22p * Vezina, Fortier et assoc, Que * 1980-04.

Cette etude vise une meilleure connaissance du regime hydrologique du cours d'eau inferieur de la riviere Eastmain et de ses affluents estuariens, la riviere La Peche et la riviere a l'Eau Froide. Elle repond a un interet suscite lors d'une etude anterieure concernant les amenagements piscicoles devant etre realises suite a la coupure des rivieres Eastmain et Opinaca. Le rapport presente la methodologie et les resultats de trois types de mesure soit, le calcul du module du bassin inferieur a partir d'observations s'echelonnant entre 1960 et 1975, les debits mensuels et les debits journaliers.

065353
WALLIS CH, BLACK TA, HERTZMAN O, WALTON VJ * **Application of a water balance model to estimating hay growth in the Peace River Region** * Atmos-Ocean * 21(3) 326-343 * 1983-09.

A model that uses daily climate data for calculating hay crop growth in the Peace River region of British Columbia was developed and evaluated using data obtained over four growing seasons. The performances of the ratio of growth to transpiration and the ratio of growth to transpiration (T) divided by vapour pressure deficit (VPD) in estimating crop growth were compared. Transpiration was calculated by subtracting evaporation losses from the soil and foliage from the calculated evapotranspiration. Evapotranspiration was calculated using solar radiation and air temperature, and a one-layer root zone water balance model, which accounted for soil water supply limitation. Soil water storage measurements showed that the water balance model worked well. The model provided satisfactory estimates of growing season yield of above-ground dry matter. The use of the ratio of growth to T/VPD showed no improvement in growth estimation over the ratio of growth to transpiration.

065807
YEE B * **Hydrologic evaluation, Blackfoot Creek near the Saskatchewan boundary** * vp * Environ Can, Environ Conserv Serv, Inland Waters Dir, West North Reg * 1983-03.

An hydrologic evaluation was conducted of Blackfoot Creek, a major tributary entering the Battle River near the Alberta - Saskatchewan boundary, to determine whether or not it should be discontinued as a hydrometric station. This report briefly describes the investigation and discusses the findings. The examination of hydrometric data resulted in the recommendation that the hydrometric station at Blackfoot Creek be discontinued.

064201
YUKON RIVER BASIN STUDY * **Second annual report of the Yukon River Basin Committee for the period April 1, 1982 to March 31, 1983** * 16p * Yukon River Basin Study, BC * (1983).

Presented in detail is the secnd annual report of the Yukon River Basin Committee for the period April 1, 1982 to March 31, 1983. The activities of the study program deal with hydrology, water quality, wildlife, tourism, parks and recreation, fisheries, socio-economic, energy, placer and information exchange. Projects already initiated and new tasks are described and a statement of expenditures is presented. The annual work program, projects, expenditures and budget are listed.

3. HYDROMETEOROLOGY - HYDROMETEOROLOGIE

3.1 Precipitation - Precipitations

067003
Fifth Symposium Meteorological Observations and Instrumentation, April 11-15, 1983,

Toronto, Ont * 572p * Am Meteorol Soc, 45 Beacon St, Boston, MA 02108 US * 1983.

This preprint volume of papers is divided into 26 sessions with 111 papers included. The sessions focus on areas of observational and measurement interests of operation meteorology and include: measurement of basic surface parameters; precipitation sensors; radiation sensors; pressure sensors; cloud and visibility sensors; radiosonde; satellite; remote profiling of the atmosphere; requirements and needs; aircraft systems; data representativeness and standards; aircraft data acquisition systems; mesoscale networks; airborne measurements; networks; automatic weather station technology; meteorological radar; optical and acoustic sensing; severe storms, lightning and thunder; air quality and boundary layer measurements; and computation and analysis. An author index is also provided for easy location and quick reference of papers.

F11954
BERON P, BARNWELL T (ED) * **Compte rendu, Colloque sur la modelisation des eaux pluviales, tenu au Holiday Inn Centre-Ville, Montreal, Quebec, Canada, 8-9 septembre 1983** * Rapp GREMU 83/03 * 274p * Ec Polytechnique Montreal & US Environ Prot Agency * 1983-10.

Dix-neuf papiers furent presentes au Colloque sur la modelisation des eaux pluviales, tenu au Holiday Inn Centre-Ville, Montreal, Quebec, les 8 et 9 septembre 1983. En autres, les sujets concernaient les relations pluie/ruissellement, la synthese des crues pluviales des petits bassins versants du Quebec, different modeles et leur utilisation, la relation qualite-debit dans un reseau unitaire, des etudes de cas, le design preliminaire d'un bassin de detention des eaux pluviales, etc.

F11834
BOSSERT E * **Pour qui sonne le verglas?** * For-Conserv * 50(10) 12-15 * 1984-03.

En novembre dernier, un territoire evalue a 55 200 hectares par Environnement Canada fut la cible d'un verglas impitoyable dans la region de Lanaudiere-Maskinonge. Il s'agit la d'une etendue importante pour un phenomene du genre, generalement local. Et les degats occasionnes aux boises furent tels qu'ils ont amene les intervenants a se questionner sur l'amenagement forestier regional. Habituellement, ces conditions meteorologiques instables ne persistent guere, mais dans cette region, elles durerent trois jours. Pour l'ensemble des peuplements forestiers echantillonnes, 37,2% des arbres furent consideres perdus. Une equipe du Service canadien des forets (Environnement Canada) a ete depechee sur les lieux; elle a procede a la cueillette de donnes, qui, meme sommaire, a fourni un etat general de la situation.

063523
CHANASYK DS, VERSCHUREN JP * **An interflow model: II. Model validation** (see chapter 4.1 for complete reference - voir chapitre 4.1 pour la reference complete)

064158
COLES GA, GRAHAM DR * **Alberta Environment real time hydrometeorological network current status (February, 1983)** * 8p * 1983-02.

The purpose of this paper is to describe the current status of the real time hydrometeorological network used by Alberta Environment in its flood forecasting operations. Some components of the network have been in place for many years; for example, the telemarks operated by Water Survey of Canada at key hydrometric sites. On the other hand, the addition of data collection platforms (DCPs) has been a fairly recent development. In order to give a complete picture, it was decided to include information on all aspects of the network, both old and new. The first part of the paper describes the network as it stands today as well as the proposed stations that are required to complete the network. For the purpose of discussion, the network has been broken into three units. The South Saskatchewan Basin, which contains the vast majority of the meteorological sites, is considered first. The Paddle River Basin, a relatively small specialized network, will be discussed next; then the hydrometric network which is comprised of stations throughout the Province. The latter part of the paper deals with the various types of telemetry employed in the network as well as the sensors used to monitor the various hydrometeorological parameters. Mention is also made of the availability of the data collected.

067005
GOODISON BE, TURNER VR, METCALFE JR * **A Nipher-type shield for recording precipitation gauges** , IN: Fifth Symp Meteorological Observations and Instrumentation, April 11-15, 1983, Toronto, Ont * 21-26 * Am Meteorol Soc, 45 Beacon St, Boston, MA 02108 US * 1983.

A larger Nipher-type shield, constructed to fit the present 8-inch diameter recording precipitation gauges used by the Atmospheric Environment Service and developed to provide more accurate recording gauge measurements of snowfall and also to provide data more directly compatible with measurements from the official MSC Nipher snow gauge, is described. Wind tunnel tests were undertaken to ascertain whether there was any difference in the flow pattern around a standard MSC Nipher shielded snow gauge and a Fischer & Porter gauge equipped with a large Nipher type shield, and to predict whether a truncated version of the large shield could be used on field installations without adversely affecting the flow regime. Field data indicate that the

large shield can be used with recording gauges to provide measurements compatible with the official Canadian MSC Nipher snow gauge and the wind tunnel experiments suggest that this should be the case.

061897
HIPEL KW, MCLEOD AI, NOAKES DJ * **Fitting dynamic models to hydr logical time series** (see chapter 4.1 for complete reference - voir chapitre 4.1 pour la reference complete)

067006
HOLMES J, MICHELENA E * **Design and testing of a new rain gauge for NDBC meteorological data buoys** . IN: Fifth Symp Meteorological Observations and Instrumentation, April 11-15, 1983, Toronto, Ont * 34-37 * Am Meteorol Soc, 45 Beacon St, Boston, MA 02108 US * 1983.

A rain gauge design using a rain storage tube, a siphon dump, and a capacitance-type water level sensor, evaluated on NDBC's Ocean Test Platform, is described. A prototype rain gauge was operated successfully on the platform for 18 months. Operation of the gauge is discussed showing that information storage (precipitation) can be performed without the need of electrical power, and that instantaneous readings of the total precipitation can be made by NDBC's operational type payloads. It is demonstrated that the capacitance probe used has a stable calibration and is not affected by the environmental temperatures at the buoy and that the siphon dump is effective and reliable.

066970
HOWARD CDD * **Forecasting the effects of severe rainfall runoff on reservoir release routing** (see chapter 4.5 for complete reference - voir chapitre 4.5 pour la reference complete)

066969
INGRAHAM DV, RUSSELL SOD * **Nowcasting areal rainfall over British Columbia from GOES satellite images** . IN: Decision making for hydrosystems: forecasting and operation, Int Symp on Real-Time Operation of Hydrosystems, Waterloo, Ont, 24-26 June 1981 * UNNY TE, MCBEAN EA * 527-539 * Water Resour Publ, PO Box 2841, Littleton, CO 80161 US * 1982.

The economical design, management and operation of a major water resource project often requires input data such as rainfall to be available in real time. For remote or sparsely gauged areas this is very difficult to provide. The weather satellites, in particular the Geostationary Operational Environmental Satellites (GOES) provide good spatial coverage of the meteorological conditions on earth on a 30-minute basis day and night. A method for estimating half-hourly rainfall from GOES infrared images has been developed at UBC and, unlike earlier procedures that concentrate on estimating rainfall from deep convective storms in the tropics, performs well in estimating rainfall from the widespread frontal systems common to British Columbia as well as purely convective systems. The method relates the rate of top growth, as revealed in the GOES infrared images, to the inflow of moisture into the base of the cloud and hence to the rainfall rate. The method has been used to estimate rainfall for a number of test storms over British Columbia and, although there were some local inadequacies, the results were remarkably successful. A simple updating procedure was developed and it showed that the satellite estimates of rainfall can be improved by including the information provided by concurrent rainfall observations. The updated model parameters can be used to improve rainfall estimates for ungauged locations. Experience to date and some of the practical considerations are discussed.

067010
JOHNSTONE KJ * **An example of climate network design for the Mackenzie River Basin** . IN: Fifth Symp Meteorological Observations and Instrumentation, April 11-15, 1983, Toronto, Ont * 366-370 * Am Meteorol Soc, 45 Beacon St, Boston, MA 02108 US * 1983.

Correlation models and optimum interpolation used in a large scale assessment of the monthly temperature and precipitation networks in the Mackenzie River Basin, are described. The optimum interpolation technique was used to assess the precipitation network and the temperature network was assessed by considering interstation correlations of mean monthly temperatures. Correlation model parameters were obtained by selecting the best set of concurrent monthly data available for the basin, removing the seasonal cycle, calculating the interstation correlations, plotting the correlations as a function of station spacing, and then estimating the parameters from the subjectively fitted line. A change in observing program or station installation was recommended for 41 sites in the basin as a step to network improvement.

F11955
LEMIEUX P * **Design preliminaire d'un bassin de detention des eaux pluviales** . IN: Compte rendu, Colloque sur la modelisation des eaux pluviales, tenu au Holiday Inn Centre-Ville, Montreal, Que, 8-9 sept, 1983 * BERON P, BARNWELL T * Rapp GREMU 83/03 * 190-204 * Ec Polytechnique Montreal & US Environ Prot Agency * 1983-10.

Nous presentons une methode simple mais flexible pour le design preliminaire d'un bassin de retenue des eaux pluviales, laquelle methode utilise un hyetogramme synthetique du type Chicago pour simuler l'averse et se base

sur le concept de ligne isochrone et la methode rationnelle pour generer le ruissellement sur le bassin de drainage. Les resultats sont presentes sous forme de courbes adimensionnelles. Grace aux variables adimensionnelles, nous pouvons comparer les methodes d'Yrjanainen-Warren, Kelly et Codere avec la methode hyetogramme-isochrone.

065222
MAATHUIS H, DYCK JH * **Assessment of summer precipitation enhancement on groundwater in Saskatchewan Crop District areas 1A, 3B-S, and 7A** (see chapter 5.1 for complete reference - voir chapitre 5.1 pour la reference complete)

063272
MATHERS T, TAYLOR CH * **Rainfall interception on a small forested watershed within the Kawartha Lakes region** (see chapter 9 for complete reference - voir chapitre 9 pour la reference complete)

061899
NGUYEN VTV * **A stochastic approach to characterization of rainfall temporal patterns** . IN: 1982 Int Symp on Urban Hydrology, Hydraulics and Sediment Control, Univ Kentucky, Lexington, KY US, July 27-29, 1982 * 263-265 * 1982.

A probabilistic characterization of temporal storm patterns was investigated wherein a storm was defined as an unbroken sequence of consecutive hourly rainfalls. A stochastic model was developed to determine the probability distribution of accumulated rainfall amounts at the end of each hour within a total n-hour storm duration. To verify the descriptive capabilities of the model, it has been applied to a 32-year hourly rainfall record at Dorval Airport in Canada. The methodology proposed here seems to be more flexible and more general than those that have been used in previous investigations.

065747
NGUYEN VTV * **A probabilistic method for the transformation of point rainfall to mean areal rainfall** . IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * 37-54 * Can Soc Civ Eng * (1983).

The present study, a continuation of a previous work by the author, suggests a new theoretical approach to the transformation of the rainfall at a fixed point to the mean rainfall over a geographically fixed area. The previous method was based on the assumption that point rainfalls measured at different stations are independent of each other. In this paper a new approach is proposed in which the spatial correlation structure of rainfall can be taken into account. Point rainfall depths were assumed to be correlated, nonidentically and exponentially distributed random variables. From this hypothesis the distribution function for mean areal rainfall has been analytically derived. The areal correction factors were then estimated at equal levels of exceedance probability for point and mean areal rainfalls. The results obtained in an illustrative example show that, by taking into account the spatial variability of rainfall, the present approach can give better estimates than the previous one.

062597
NKEMDIRIM LC, MELLER BD * **Assessment of "true" variability of small rainfall events in a small mountainous watershed in the summer** * Nord Hydrol * 13(4) 205-212 * 1982.

The standard error of mean areal rainfall was calculated for various densities of rain gauge network in a small mountainous watershed in the summer of 1978. It is shown that a) the optimum gauge density required to assess mean rainfall is about 3 gauges/sq km; b) the "true" variability in the spatial distribution of rainfall decreases with increasing rainfall amount; and c) the relationship between "true" variability and rainfall volume is linear in that watershed.

062444
PAUL AH * **The thunderstorm hazard on the Canadian Prairies** (see chapter 4.2 for complete reference - voir chapitre 4.2 pour la reference complete)

F11784
SARAZIN R * **Utilisation du dosage en oxygene 18 dans la pluie et la vapeur d'eau** * 107p * Univ du Que a Montreal, Que * 1980-07.

Cette etude se propose d'examiner les divers processus de fractionnement qui determinent la composition isotopique de la pluie et de voir, de quelle facon cela peut se traduire dans la pluie a Montreal. Des echantillons de pluie et de vapeur d'eau servent a examiner la relation entre le dosage isotopique et d'une part la temperature a differents niveaux dans les nuages contribuant a la formation des precipitations, et d'autre part, la provenance de la masse d'air dans laquelle les nuages se sont formes. Les resultats de cette etude sont expliques a l'aide de modeles theoriques simples qui tiennent compte du dosage isotopique des gouttelettes d'un nuage et de la croissance des gouttes precipitantes. Ceci permet de determiner dans quelle mesure il est possible d'utiliser le dosage isotopique comme outil de recherche pour l'etude de la physique des precipitations.

067011
SAULESLEJA A, LOUIE PYT * **An evaluation of the real-time observing network for estimating basin precipitation over the Upper Great Lakes** . IN: Fifth Symp Meteorological Observations and Instrumentation, April 11-15, 1983, Toronto, Ont * 384-386 * Am Meteorol Soc, 45 Beacon St, Boston, MA 02108 US * 1983.

Results of a simple approach in the assessment of a network to measure areal precipitation, based on the interstation correlations of the monthly precipitation data, are presented for a preliminary qualitative evaluation of the existing real-time network for the Upper Great Lakes region. An analysis of 24 stations providing precipitation data for the period 1971-1980 is used. The interstation correlation of the monthly precipitation time series for each station pair was computed and maps of the correlation field were then drawn using each station as the center point. The addition of real-time precipitation stations in areas where less than 50% of the monthly variation in precipitation can be accounted for by stations in the current network is used. Further study is considered necessary to refine the selection of the location and seasons for operation. Other areas of further study are also outlined.

066688
STRACHAN WMJ, HUNEAULT H * **Evaluation of an organic automated rain sampler** * Tech Bull No 128 * 5p * Natl Water Res Inst, Inland Waters Dir, Can Cent Inland Waters, Environ Can, Burlington, Ont * 1982.

An automated rain sampler has been designed, built and evaluated as a collecting device for persistent organic chemicals in rain. It consists of a large Teflon-coated funnel (0.209 sq m) with an automated lid and a Teflon column containing XAD-2 or XAD-7 resin. The sampler was tested for recoveries and field precision with a number of organochlorine substances and polychlorinated biphenyls (PCB's) frequently found at the nanogram per litre level in rain. Recoveries averaged 86% and the mean coefficient of variation for alpha-BHC, lindane and PCBs was 33% under field conditions where samples of 0.4-22 L of rain were collected. The sampler is recommended for use in network sampling for these persistent organic compounds.

064648
VERSCHUREN JP, WOJTIW L * **Estimate of the maximum probable precipitation for Alberta river basins** * RMD-80/1 * 307p * Alta Environ, Hydrol Branch * 1980-06.

Point measurements of maximum depth showed that over 50% of the rainstorms occur in June and July, with only a small percentage in April (5.6) and September (10.1). The greatest frequency of occurrence is observed in the Waterton Lakes Park area (just about 1 per year), with relatively high frequencies along the continental divide and decreasing eastward along the foothills and plains of Alberta. Point measurements of maximum depth also showed that the greatest frequencies of occurrences are those in the Waterton Lakes Park area with probability of 2.0 (twice a year) for depths 50mm and more; 0.38 (1:3 year event) for depths 100 mm and more; and 0.09 (1:10 year event) for depths 150 mm and more. Seasonally the greatest frequencies are observed in June for southern Alberta and in July for central Alberta. Severe storms (150 mm and greater in depth) are observed to occur in four main regions of the province. Estimates of "Probable Maximum Precipitation" (PMP) using the meteorological approach were made for six river basins for 6-, 12-, 24-, 48-, 72-, 96-hour rainfalls. The maximum estimates of the PMP seem to occur in June for the basins in the southern portion of the province, while in central and northern Alberta the maximum estimates were found to occur in July. Spatial variability of the PMP is also observed in each of the river basins. The largest decrease of the maximum PMP is recorded in the South Saskatchewan River basin. Here at the eastern edges of the basin, the PMP estimates are about 80% lower than those calculated at the western edges. A second method of estimating the PMP, using the statistical technique developed by Hershfield, was also applied to 27 first-order stations. These estimates were about 50mm higher (for areas of about 250 sq. km) in the six river basins. The largest estimates by this technique were also obtained in the South Saskatchewan River basin.

064007
WILSON JW, POLLOCK DM * **Precipitation** , IN: IFYGL - The International Field Year for the Great Lakes * AUBERT EJ, RICHARDS TL * 51-78 * Natl Oceanic Atmos Adm, Great Lakes Environ Res Lab, US Dep Commer, Ann Arbor, MI 48104 US * 1981-03.

To meet requirements by both the Lake Meteorology and Terrestrial Water Balance Programs of IFYGL, four separate projects were carried out during the Field Year to measure precipitation falling on Lake Ontario and/or on the land within the Ontario basin. Primary objectives were to measure the daily total precipitation falling on the lake and land portion of the Lake Ontario basin; estimate the accuracy of the precipitation measurements, determine the type of precipitation falling on the lake and to investigate land-to-lake precipitation differences. Precipitation data were available from three weather radars and 376 precipitation gages. Most of the gages used were the Canadian and United States first-order and climatological stations. Gage data were also obtained from special island, shoreline, and tower installations. For snow measurement studies and error analyses, three

precipitation gage mesonetworks were installed. This report summarizes the results of these four projects, highlighting major findings.

3.2 Precipitation Chemistry = Chimie des precipitations

064553
Acid rain, research concentrates on three labs * Legacy * 11(4) 18-25 * Ont Minist Environ, Commun Branch, 135 St Clair Ave West, Toronto, Ont M4V 1P5 * 1983.

This article discusses the research projects at 3 Environment Ontario labs, in Dorset, Toronto and Brampton, on acid rain and its effects on water, plant and animal life, and on ways and means to solve the problem. Dorset is the focal point of field studies. Intensive studies of acid rain are concentrated on 8 lakes within 30 km of Dorset. Other studies concern: leaching of mercury, cadmium, lead, aluminum, manganese and iron from rock; chemical effects and biological responses in 30 watersheds; the measuring of depositions, expressing all data in numerical form for computer models; and dust as a factor in acid rain effects. The effects of acid rain on agricultural crops and forests are studied in the phytotoxicology section of the Air Resources Branch at the controlled-environment greenhouse and growth chamber facilities in Brampton.

063922
United States - Canada Memorandum of Intent on Transboundary Air Pollution, Executive summaries, Work Group reports * vp * 1983-02.

Executive summaries are presented of Working Group Reports in fulfillment of the requirements of the Memorandum of Intent on Transboundary Air Pollution signed by Canada and the United States on August 5, 1980. The Impact Assessment Work Group, was charged with identifying and making an assessment of the key physical and biological consequences related to transboundary air pollutants. A summary is presented of the findings with respect to impacts on aquatic and terrestrial sectors of the biosphere, health and visibility, and man-made structures. Summary statements are also given with regard to methodologies for estimates of economic benefits of controls, natural and material resource inventory, and liming. The Atmospheric Sciences and Analysis Work Group developed information on the application of current long range transport models and acidic deposition monitoring data. The main conclusions are summarized under the headings: observations on deposition, mass budget studies and man-made versus natural sources, local versus long range transport, atmospheric transformations and deposition of sulfur compounds and long range transport models as assessment tools. The third report reviews emissions of pollutants that undergo transboundary transport, the currently available technologies (process and control), costs of their application for the reduction of SO2 and NO emissions for both new and retrofit installations, and research and development activities.

061975
AIR RESOUR BRANCH, ONT MINIST ENVIRON, TORONTO, ONT M5S 1Z8 * **Daily precipitation chemistry listings and statistical summaries July 15, 1980 - December 31, 1981** * Acid Precip Ont Stud 001/82; ARB-19-82-ARSP * 327p * Ont Minist Environ, 40 St Clair Ave W, Toronto, Ont M4V 1P5 * 1982-07.

This publication lists data which represent a summary of the results acquired from the Acidic Precipitation in Ontario Study (APIOS) daily precipitation sampling network from July 1980 - December 1981. It is divided into five parts: 1) Introduction; 2) Station description and location map - defined by four descriptive fields, namely, sampling location, sampling interval, instrumentation, and index code utilized on the location map; 3) Daily precipitation chemistry summary statistics; 4) Daily precipitation deposition summary statistics; and 5) Daily precipitation chemistry listings. Results of chemical analysis done on unfiltered samples are presented, with laboratory pH entries representing pH measurements at the MOE Laboratory and field pH entries representing measurements at regional laboratories. Chemical analysis parameters include total hydrogen, hydrogen ion concentration, sulphate, ammonia as nitrogen, nitrate as nitrogen, calcium, chloride, magnesium, potassium, sodium and free hydrogen. Precipitation chemistry and deposition summary statistics are generated including all data available. Arithmetic mean, arithmetic standard deviation and volume weighted mean are presented for all the parameters except pH because they are deemed useless for a parameter which is logarithmically related to the free hydrogen ion. Calculations of equivalent precipitation depth and of observed sampling efficiency, are explained.

066844
ALTSHULLER AP, LINTHURST RA (ED) * **The acid deposition phenomenon and its effects: Critical assessment review papers: Volume 1, Atmospheric sciences, Public review draft** * vp * United States Environ Prot Agency, Off of Res And Dev, Washington, DC 20460 USA * 1983-05.

This portion of the Review Papers addresses the various atmospheric processes starting with emissions to the atmosphere from natural and anthropogenic sources an leading up to the presence of acidic and acidifying substances in the atmosphere. It concludes with the

deposition of these substances from the atmosphere to the surfaces of man-made and natural receptors. The objective of these papers is to provide an understanding of these phenomena and the latest technical data base supporting this understanding. Papers in this document identify the acidic and acidifying substances emitted from natural and anthropogenic sources. Natural sources are classified as geophysical and biological. The former includes volcanic and sea spray contributions, the latter, soil and vegetation contributions. The anthropogenic source categories include electric utilities, industrial combustion sources, commercial and residential combustion sources, highway vehicles, and miscellaneous sources. Emission patterns are given for spatial, seasonal, and temporal variations. Other topics cover pollutant transport processes, ie., the movement of emissions from sources to receptors; atmospheric transformation processes which result in pollutant transformation to acidic compounds; atmospheric concentrations and distributions of chemical substances; precipitation scavenging processes; dry deposition processes and deposition monitoring networks; and long-range transport and acidic deposition models.

066846
ALTSHULLER AP, LINTHURST RA (ED) * **The acid deposition phenomenon and its effects: Critical assessment review papers: Volume 2, Effects sciences, Public review draft** * vp * United States Environ Prot Agency, Off of Res and Dev, Washington, DC 20460 USA * 1983-05.

This volume of the Review Papers addresses pollutant deposition and the effects (both measured and potential) of acidic deposition. Papers deal with: the effects of acidic deposition on soil systems with special emphasis on nutrient cycling; vegetation effects, with consideration given to the potential indirect effects; the water chemistry component of the system, this is reviewed from a watershed perspective; a discussion of aquatic organism responses to changing water chemistry; the indirect effects on human health; and a discussion of the effects on materials, both natural and man-made.

064966
ALTWICKER ER, JOHANNES AH, CLESCERI NL * **Acid deposition measurements in the northeastern U.S.A.** . IN: Proc 73rd Annu Meet Air Pollut Control Assoc, Montreal, Que, 22-27 June 1980 * V5 15p * (1980).

The main cations and anions responsible for acid precipitation are H+, Ca++, NH4+, SO4(--), NO3(-), and Cl(-). A spatially concentrated network for sampling should be able to provide a reasonably accurate quantitative measure of the atmospheric inputs due to precipitation events. It should be possible to ascertain if samplers separated by shorter distances (1-30 km) receive identical inputs. If so, data from such a network could be treated as a single point, and compared to regional network data. A more concentrated network was desired to measure the precipitation inputs into 3 separate lake watersheds, on the western slope of the Adirondack Mountains in New York State. One of the overall objectives of the study is to ascertain if the 3 watersheds receive similar atmospheric inputs. This paper gives an overview of the data base for major ions for the first year of the study; some comparisons with measurements made by other networks are presented also. The precipitation inputs into the 3 watersheds are comparable. The data presented confirm seasonal patterns; summer rains are dominated by sulfuric acid, whereas nitric acid plays a minor role only. Correlations based on air mass trajectories and storm types are possible ways in which to analyze the data. In this paper only linear correlations are reported.

062390
ARAFAT NM, GLOOSCHENKO WA * **The use of bog vegetation as an indicator of atmospheric deposition of arsenic in northern Ontario** (see chapter 4.9 for complete reference - voir chapitre 4.9 pour la reference complete)

063866
BARRIE LA * **Interpretation of network data: spatial and temporal variations** , IN: Proceedings, Symposium on Monitoring and Assessment of Airborne Pollutants with Special Emphasis on Long-Range Transport and Deposition of Acidic Materials and Workshop on Air and Precipitation Monitoring Networks, Ottawa, Canada, 30 August - 3 September 1982 * PIERCE RC, WHELPDALE DM, SHEFFER MG * NRCC 20642 * 383-411 * Natl Res Counc Can, Assoc Comm Sci Criteria Environ Qual, Ottawa, Ont K1A OR6 * 1983.

Measurements of the concentration of acid-related substances in air and precipitation are done routinely in Canada on a variety of temporal and spatial scales. Current networks, their objectives, configuration, operations, and products are reviewed. This is followed by a general discussion of factors that need to be kept in mind when interpreting data, including observational uncertainties and the representativeness of a point measurement in time or space. Methods of extracting information on spatial distributions and temporal trends of precipitation chemistry data are suggested. The review leads to recommendations on how to improve present monitoring efforts.

064063
BARRY B * **Acid rain and forest productivity** (see chapter 9 for complete reference - voir

chapitre 9 pour la reference complete)

066839
BAYLEY S * **Interim report for effects of acid precipitation on the mobilization of toxic trace metals from bogs to freshwater fish habitats** * vp * 1983-03-31.

This report contains results of testing done between 1971 - 1981 on effects of acid precipitation from bogs in Northwestern Ontario. Results show that the 1974 and 1980 fires have had no major effects on the vegetation of Bog 239NE. The report details results of chemical testing in the bogs. The bog watershed generally exports higher concentration and greater masses of elements than the forested watershed. The major nutrient elements (nitrogen, carbon, phosphorus, sulphur) are retained better by the forested ecosystem than by the bog system. Elements (calcium, sodium, chlorine, potassium) derived primarily from weathering show no differences in export in bog and forests. Chloride is retained in all watersheds as are nitrogen and phosphorus. Hydrogen ion is retained in forested watersheds better than bog watersheds. Disturbance of the watersheds (fire or clearcutting) appears to raise the export of carbon and sulphate. The report concludes that the 239NE bog site appears the best for future acidification experiments.

066982
BECKING GC * **Long range transport of acidic pollutants - knowns and unknowns** . IN: Acid deposition, knowns and unknowns: the Canadian perspective, Proc, Montreal, Que, 7-8 Apr 1981 * 7p * APCA (Air Pollut Control Assoc) (Ontario/Quebec) and Fed/Prov LRTAP Sci Comm * (1981).

This paper emphasizes the health effects arising from the long range transport of air pollutants (LRTAP). The LRTAP process may also cause environmental changes which have an indirect impact on human health. Of immediate concern is the potential for increased levels of mercury in man's food chain. Acid deposition can lead to leaching of toxic metals from the watershed and corrosion of metallic materials used in reservoirs and drinking water distribution systems. More appropriate monitoring data (both quantity and species) is needed to calculate man's exposure to toxic chemicals subjected to LRTAP. Without such information, health officials cannot quantify health risks from direct and indirect effects of LRTAP.

063908
BENNETT EB * **Effects of acid precipitation in a watershed of moderate buffering capacity** * Manuscr Rep Ser No 11 * 26p * Res Dev, Ocean Sci Surv, Cent Reg, Can Cent Inland Waters, Fish Oceans, PO Box 5050, Burlington, Ont L7R 4A6 * 1981-07.

A method for estimating the impact of acid precipitation on watersheds with substantial buffering capacity is described. Observed calcium concentrations in runoff water are used to identify groundwater fraction in the discharge, and groundwater characteristics. CO2 outgassing parameters are determined from data on CO2 excess (calculated from pH and alkalinity) as a function of streamflow. The relationship of stream pH to flow rate is developed as a function of rain pH, and, when combined with streamflow statistical data, is used to estimate expected durations of arbitrary pH levels. Strongly acidic pulses commonly observed during spring run-off in rivers are due primarily to the effect of excess CO2, but the strength of such pulses is directly related to the degree of acid loading.

063871
BEZAK D, OLSON R * **Data validity and comparability** , IN: Proceedings, Symposium on Monitoring and Assessment of Airborne Pollutants with Special Emphasis on Long-Range Transport and Deposition of Acidic Materials and Workshop on Air and Precipitation Monitoring Networks, Ottawa, Canada, 30 August - 3 September 1982 * PIERCE RC, WHELPDALE DM, SHEFFER MG * NRCC 20642 * 462-465 * Natl Res Counc Can, Assoc Comm Sci Criteria Environ Qual, Ottawa, Ont K1A OR6 * 1983.

Actions which could be implemented to improve the quality, availability and reliability of air and precipitation chemistry data, are proposed in this working group's report. Discussions centred on the identification of problems and formulation of practical recommendations for improvements that could be affected by specific agencies or monitoring network managers. To ensure data validity and comparability within and among monitoring networks, recommendations are presented in four areas: data needs and utilization; validity of data; data comparability; and data availability.

066990
BOTTENHEIM JW * **An overview of atmospheric chemistry as it relates to acid deposition** , IN: Acid deposition, knowns and unknowns: the Canadian perspective, Proc, Montreal, Que, 7-8 Apr 1981 * 31p * APCA (Air Pollut Control Assoc) (Ontario/Quebec) and Fed/Prov LRTAP Sci Comm * (1981).

The subject of this paper is the chemical processes in the atmosphere that transform the primary pollutants, sulfur dioxide and nitrogen oxides, into sulfuric and nitric acid. Physical effects such as mixing and dilution, temperature and solar radiation, and transport through the atmosphere are not discussed here. Gas phase chemistry, involving photochemically produced radicals, plays a dominant role, although chemistry in

the liquid phase, particularly for the oxidation of SO2 is also important. While gas phase chemistry is, at least in theory, reasonably understood, major problems have to be untangled for liquid phase chemistry. Data on the conversion of NOx to HNO3 are very limited. There is a growing school of thought that the term "acid rain" is a misnomer, and that for a true understanding of the problem one should focus upon the negative ion content (HSO3 -, SO3 --, HSO4 -, SO4 --, NO3 -) of anthropogenically polluted deposition.

F10641
BROOKSBANK P * **Reseau canadien d'echantillonnage des composes organiques des precipitations** * Etude no 129, Collect rapp tech * 49p * Environ Can, Dir gen eaux inter, Dir qual eaux, Ottawa, Ont * 1983.

Des echantillons de precipitations ont ete recueillis en douze endroits repartis a travers le Canada et on en a determine les teneurs de plusieurs pesticides organochlores et PCB. Les echantillons ont ete obtenus a l'aide d'un echantillonneur de precipitations automatique. Divers problemes touchant l'echantillonneur et la technique d'echantillonnage ont fait les donnees ne sont que qualitatives. On pense cependant qu'elles representent probablement des valeurs minimales et indiquent un transport atmospherique de ces composes vers des regions reculees. Des recommandations sont fait visant l'elaboration d'un echantillonneur ameliore.

064690
BRUN GL * **Data summary report for trace organic contaminants in precipitation collected at Kejimkujik National Park, N.S. and Ellerslie, P.E.I. during 1982** * IWD-AR-WQB-83-44 * np * Inland Waters Dir, Atl Reg, Water Qual Branch, Environ Can, Moncton, NB * 1983-05-12.

Twenty-four wet precipitation samples collected during 1982 were analyzed for organochlorine pesticides, polychlorinated biphenyls, chlorinated benzenes and polyaromatic hydrocarbons. The ubiquitous compounds, alpha-BHC, Lindane, PCBs and Fluoranthene were observed in most samples with mean annual concentrations in the low part per trillion range. An unusually high annual mean PCB concentraton of 0.18 micro g per L is attributed to a local unknown source(s). Other contaminants in addition to the above were detected on an infrequent basis at levels near the limits of detection.

066987
BRYDGES T * **Aquatic effects of acid deposition - water quality** , IN: Acid deposition, knowns and unknowns: the Canadian perspective, Proc, Montreal, Que, 7-8 Apr 1981 * 5p * APCA (Air Pollut Control Assoc) (Ontario/Quebec) and Fed/Prov LRTAP Sci Comm * (1981).

The three fundamental questions regarding the aquatic effects of the deposition of strong acids are: how much strong acid is coming down, what happens to it, and what are the chemical and biological consequences in soil and water? One approach to answering all three questions has been the use of "calibrated watersheds" and "calibrated lakes". These are simply ecosystems for which the input and output of chemical substances, including water, are measured. Calibrated watersheds are currently under study at eight locations: Kenora, Sault Ste Marie, Dorset, Laurentide Park, Kejimkujik Park in Canada, and Sagamore Lake, Hubbard Brook and Coweeta in the United States. The Canadian/US Working Group on Aquatic Impacts has recommended that first priority be given to control of sulfate deposition, and have established some target loadings as guidance for the abatement strategy work groups. It is empirically clear that loadings at Dorset, Hubbard Brook and Kejimkujic Park are causing water quality and biological damage. On the other hand, water quality damage at Kenora appears minimal.

067176
CAMPBELL PGC, STOKES PM, GALLOWAY JN * **Effects of atmospheric deposition on the geochemical cycling and biological availability of metals** , IN: Int Conf Heavy Metals in the Environment, Heidelberg, September 1983 * Mueller G (chairman) * 760-763 * CEP Consult Ltd, 26 Albany St, Edinburgh EH1 3QH GB * 1983.

In an attempt to identify those metals that should be of primary concern in the context of acid deposition, 18 metals of potential environmental importance (Ag, Al, As, Be, Cd, Co, Cu, Hg, Mn, Mo, Ni, Pb, Se, Sn, Te, Tl, V and Zn) have been evaluated with respect to four factors: (i) anthropogenic contributions to metal deposition from the atmosphere; (ii) geochemical mobility in response to environmental acidification; (iii) sensitivity of metal speciation to pH changes; (iv) toxicity and bioaccumulation potential. Consideration of these factors allowed the classification of the metals of concern according to their potential impact in geologically sensitive ecosystems receiving acid deposition; Al, Cd, Cu, Hg, Mn, Pb and Zn were identified as metals meriting particular attention in this regard.

062997
CARROLL J * **Acid rain diplomacy: the need for a bilateral resolution** * Alternatives * 11(2) 9-12 * Alternatives, c/o Trent Univ, Peterborough, Ont K9J 7B8 * 1983.

This article is based on the author's book, Acid rain: an issue in Canadian-American relations (CD Howe Institute, Toronto, and National Planning Association, Washington, 1982). The problem of acid rain is a serious one. Canada has unilaterally raised the acid

rain issue and given it a high place on the diplomatic agenda, and United States has failed to respond substantively to this concern, sending a very negative signal back to Canada. At least 50% of Canada's acid deposition comes from United States, and only 15% of US acid deposition comes from Canadian sources. Much of Canada is geologically vulnerable to the impacts of acid deposition. Canada is dependent upon the forest products industry, which is probably inhibited by acid rain. Also, Canadians are more aware of the effects of acid rain. The International Joint Commission (IJC) and its Great Lakes Water Quality Committee, first brought to the attention of Ottawa the increasing threat of acid rain as a bilateral problem. Canada has offered to reduce Canadian SO2 emissions by 50% by 1990 if United States will do likewise. This can be achieved without scrubber technology, through: application of universal and mandatory coal pre-washing at mine mouth; widespread use of Least Emissions Dispatching; somewhat greater reliance on low sulphur coal in the fuel mix; and more innovative use of regulatory legislation which permits trade-off of nitrogen oxide and SO2 reductions. A new vehicle for acid rain control is needed, which could perhaps be called the Canada-U.S. Bilateral Air Quality Commission, and would involve private as well as public sector interests.

062537
CARROLL JE * **Acid rain: an issue in Canadian-American relations** * 75p * Can-Am Comm, 2275 Bayview Ave, Toronto, Ont M4N 3M6 * 1982-07.

The bilateral environmental relationship between Canada and the United States has deteriorated substantially, partly due to acid rain. This study analyzes this complex and challenging phenomenon in the bilateral relations between the two countries. It is not intended to address the scientific and technical debate over the problem, nor to address the substantial differences of opinion within both countries over real or perceived effects on man and natural ecosystems. It is intended to demonstrate that a serious problem is emerging in diplomatic relations, which must be recognized, understood and jointly solved. United States accounts for 84% of the SO2 and 92% of the nitric acid in acid rain over the 2 countries; Canada accounts for 16% and 8% respectively. Environments with high alkalinity, or rich in calcium and magnesium, are not hurt by acid rain. At the other extreme are highly acidic environments such as the granitic regions of the Canadian Shield, the Appalachians, portions of the Rockies and other mountains, which have no buffering capacity. Much of Canada is highly vulnerable, but only parts of United States. At present, Canada argues for immediate action to reduce SO2 emissions by 50% by 1990, while the United States argues that more research is needed. Diplomatic negotiation is at a standstill. Imbalance in the transnational movement of pollutants, in vulnerability, in commercially valuable forest endowment in vulnerable areas, and in the public's awareness level of acid rain, all contribute to the problem in Canadian-American relations. The report outlines the European experience in controlling transnational acid rain, and suggests a solution to the Canada-United States diplomatic impasse.

063863
CHAN WH * **Quality assurance - monitoring of wet deposition** . IN: Proceedings, Symposium on Monitoring and Assessment of Airborne Pollutants with Special Emphasis on Long-Range Transport and Deposition of Acidic Materials and Workshop on Air and Precipitation Monitoring Networks, Ottawa, Canada, 30 August - 3 September 1982 * PIERCE RC, WHELPDALE DM, SHEFFER MG * NRCC 20642 * 315-340 * Natl Res Counc Can, Assoc Comm Sci Criteria Environ Qual, Ottawa, Ont K1A OR6 * 1983.

Although the importance of quality assurance in air pollution measurements has been recognized, specific discussions on quality assurance of wet deposition measurements are relatively scarce. With the ultimate goal of an integrated network of monitoring background wet deposition on a regional basis, a quality assurance program is proposed in terms of network design, site and sampler selection, sampling, chemical analysis, and data processing. Specific procedures are recommended to ensure that data collected by current and future networks are compatible and of high quality.

062093
CHAN WH, ORR DB * **An overview: the event wet/dry deposition network** * API 002/82 * 16p * APIOS Coord Off, Ont Minist Environ, 6th floor, 40 St Clair West, Toronto, Ont M4V 1P5 * 1982-07.

This report presents an overview of the Acidic Precipitation in Ontario Study (APOIS) Event Wet/Dry Deposition Network, which collects precipitation and air filter samples on a daily basis for the determination of both wet and dry short term deposition. Event sampling allows for the investigation of the characteristics of deposition events and for determination of the origin of the pollutants deposited in these events. The Event Wet/Dry Deposition Network consists of two components - one for the measurement of wet deposition and the other for the measurement of dry deposition. The Daily Wet Deposition Network studies the chemical composition, frequency and intensity of acidic precipitation episodes in the province and determines the wet deposition of acid-related materials associated with air masses originating from different directions. The Daily Dry Deposition Network determines the amount and origin of airborne acid-related pollutants

available for deposition in Ontario on a daily basis. As well, the network estimates dry deposition rates of these pollutants on a daily basis by using the airborne concentrations and appropriate deposition velocity x concentration. It also determines the dry deposition of acid-related materials associated with air masses originating in different sectors. The network design is described and network sampling locations and siting criteria are given. The instrumentation used, the collection of samples and handling techniques are described. The methods of chemical analysis are given and the handling and analysis of data are described.

066989
CHOQUETTE PJ, VENA F * **Emissions - sources of concern, an overview** . IN: Acid deposition, knowns and unknowns: the Canadian perspective, Proc, Montreal, Que, 7-8 Apr 1981 * 16p * APCA (Air Pollut Control Assoc) (Ontario/Quebec) and Fed/Prov LRTAP Sci Comm * (1981).

This paper deals with the sources and emissions of sulfur dioxide and nitrogen oxides, the present situation and some projections to the end of the century for both Canada and the United States. This information is essential to define the problem of acid deposition and for any scientific analysis of the linkages between releases of pollutants to the atmoshpere and possible environmental effects hundreds to thousands of kilometers downwind. Graphs show current emissions of SO2 and NOx in both Canada and United States, broken down by source. Figures show magnitude and distribution of SO2 and NOx in Eastern North America. Projected SO2 and NOx emissions from the United States and Canada are tabulated. These projections do not include any major emission reduction resulting from significant control measures.

066801
CLARKE AJ * **The use of Nova Scotia coal for power generation - the options for environmental protection** * 100p * British Electr Int Ltd, 30 Millbank, London SW1P 4RD GBR * 1980-01.

This report examines the environmental consequences of increasing the future use of indigenous coal for electricity generation in Nova Scotia. Part One of the report deals with the environmental effects of sulphur dioxide emissions. It discusses the options available to control these emissions, whether before, during or after combustion, and also the consequential solid waste disposal problems that arise in many of the options under consideration. In conclusion the costs and secondary environmental impacts of SO2 emission limitation processes remain as net disbenefits since most of the duty of compliance with ambient air quality standards would still be performed by stack dispersion. Stack dispersion remains the only viable option for meeting short range ambient quality standards for SO2. Part Two of the report examines the environmental impact of emissions, other than sulphur dioxide, arising from the combustion of Nova Scotian coal for power generation. The topics covered are: particulates, nitrogen oxides, and other constituents of flue gases including trace elements.

066899
COMM ATMOS TRANSP CHEM TRANSFORM ACID PRECIPITATION, ENVIRON STUD BOARD, COMM PHYS SCI MATH RESOUR AND NATL RES COUNC * **Acid deposition, atmospheric processes in eastern North America, a review of current scientific understanding** * 375p * Natl Acad Press, 2101 Constitution Ave NW, Washington, DC 20418 US * 1983.

The main issues of concern in this report are the adequacy of current scientific understanding about the relationships between emissions and acid deposition, the extent to which the relationships are nonlinear, and the extent to which distant sources contribute to deposition in ecologically sensitive remote areas. The report describes the state of knowledge as of the end of 1982 regarding the atmospheric processes relating to emissions of precursor gases and acid deposition and the focus is on conditions in portions of eastern North America. Chapter 2 is a general review of the current theoretical understanding of the major atmospheric processes involved in acid deposition: transport and dispersion, chemical transformation, and deposition. Chapter 3 is a general review of the theoretical models currently used or proposed for assessing the relationships between sources and receptors, while Chapter 4 reviews and analyzes field data on deposition to develop a phenomenological understanding of acid deposition in North America. Needed research is described in Chapter 5. More complete reviews are contained in the four appendices.

066988
COOLEY JM * **Aquatic effects: water quality and fisheries** , IN: Acid deposition, knowns and unknowns: the Canadian perspective, Proc, Montreal, Que, 7-8 Apr 1981 * 4p * APCA (Air Pollut Control Assoc) (Ontario/Quebec) and Fed/Prov LRTAP Sci Comm * (1981).

This paper discusses some of the known and potential impacts of acid deposition on the freshwater fisheries resource of Eastern Canada. The effects on the LaCloche area near Georgian Bay are well documented. There is also evidence of acidification of aquatic environments in other areas of Ontario (Algoma and Muskoka-Haliburton). In Nova Scotia, many of the Atlantic salmon streams are suffering from high acidity. Treating the water with

calcium carbonate has been found to dramatically reduce salmon fry mortality.

064758
COURAGE IH * **Control of acid precipitation by public international law** * Water Qual Bull * 8(3) 133-136,168 * WHO Collaborating Cent on Surface and Ground Water Qual, Can Cent Inland Waters, Burlington, Ont * 1983-07.

This article covers public international law applicable to the acid rain problem leaving aside possible private actions before interventions in the administrative system of a foreign country. There are some obligations that international law imposes on states with regard to transfrontier pollution in the form of acid rain. First of all, they must observe the duty of due diligence, that is to say, they are obliged to observe all care so as to prevent the pollution of areas beyond their jurisdiction and to combat it, when it occurs. There is also the principle of good neighbourliness according to which every state is forbidden to allow its territory to be used in a way prejudicial to the rights of other states. The unrestricted dumping of effluent in the air is also restricted because of the principles of solidarity and equitable sharing. Other procedural duties, following the duty to provide information, are the duties to consult, negotiate, and cooperate.

065567
COURAGE IH * **Acid rain and international law** , IN: Acid rain/fisheries, Proc Int Symp on Acidic Precipitation and Fishery Impacts in Northeastern North America, Ithaca, NY, 2-5 Aug 1981 * HAINES TA (chairman) * 317-326 * Am Fish Soc, Northeast Div, 5410 Grosvenor Lane, Bethesda, MD 20814 US * 1982.

As most instances of acid rain involve transfrontier pollution, it can generally only be regulated on the international level. International law does not contain specific rules or regulations dealing with transfrontier pollution, and therefore all controversies must be solved on the basis of general principles of law. However, international environmental law is developing rapidly. Actions in international private law can only be initiated if these 3 conditions are met: the victim as well as the polluter must be identifiable; the court must be competent to deal with the case; and the court must be able to provide an adequate and enforceable remedy. Local actions are presently ill-suited to deal with the problems of acid rain. Polluters as well as victims are usually not identifiable. There is uncertainty about jurisdiction and applicable law. Available remedies may be restricted to compensation for material damage, and verdicts are difficult to execute. Therefore public international law, law applicable between states, is relevant. A state may take up cases on behalf of individual victims with the government on whose territory the polluting action took place. This is called exercising diplomatic protection. However, no state is obliged to espouse any private claim. International Law can be found primarily in international conventions, international customary law, and general principles of law. There are no general international conventions establishing rules on pollution or environmental quality. Acid rain is too recent a phenomenon. States must observe due diligence, that is, they are obliged to take all due care to prevent pollution of areas beyond their jurisdiction, and to combat such pollution. The concept of due diligence has been established over 100 years. The second general obligation of states flows from the good neighborliness principle. Thirdly the principles of solidarity and equity are relevant. The nature of liability for transfrontier pollution has not yet been precisely established. The enforcement of international environmental law constitutes a major problem. Once reliable and convincing scientific data are known, international law should regulate industrial activities so that the environment can be preserved.

065565
COWLING EB * **An historical perspective on acid precipitation** , IN: Acid rain/fisheries, Proc Int Symp on Acidic Precipitation and Fishery Impacts in Northeastern North America, Ithaca, NY, 2-5 Aug 1981 * HAINES TA (chairman) * 15-31 * Am Fish Soc, Northeast Div, 5410 Grosvenor Lane, Bethesda, MD 20814 US * 1982.

The purpose of this paper is to provide a chronology of some of the scientific contributions and to analyze some of the events that have led to recognition of acid precipitation as an important ecological and environmental problem. Scientific awareness of acid precipitation developed first in Europe and then later in Canada and the United States. Modern awareness developed in three separate fields of science: limnology (the study of lakes), agriculture, and atmospheric sciences. Integration of knowledge in these three fields has added greatly to the completeness of our present understanding. Analysis of the chronology and progress of these scientific events leads to three important generalizations: 1) scientific and public understanding of the phenomenon of acid precipitation and its effects on biological systems and materials has increasd substantially in recent years; but our knowledge needs to be expanded still further; 2) our present understanding of acid precipitation has depended greatly on the penetrating insight of a few scientists of unusually broad interests; and 3) we need to learn a great deal more about the complex physical, chemical, and biological world in which we live, work, and exert so many influences - both intended and unintended.

063410
CRISMAN TL, BREZONIK PL * **Acid rain: threat to sensitive aquatic ecosystems** * 22p * Univ Florida, Gainesville, FL US * (1980).

The effects of acid precipitation on sensitive (softwater) temperate lakes are reviewed, and comparative results are presented on 20 warm temperate/subtropical lakes in Florida. Results indicate a lowering of pH, a loss of alkalinity, and an increase in sulfate in softwater lakes of northern Florida over the past 25 years, whereas a group of softwater lakes in south central Florida (near the present southern boundary of acidic rain) has not become more acidic over this period. Average chlorophyll a levels decreased with decreasing pH in the 20 lakes; the trend was not wholly explained by a similar trend between total phosphorus levels and pH. Phytoplankton populations changed markedly as a function of pH, with green algae replacing blue-greens and a general reduction in both biomass and species richness in acidic lakes. More subtle effects were seen for zooplankton and benthic invertebrate communities; nonetheless distinct differences were observed between acidic lakes (pH less than 5.5) and nonacidic lakes. Preliminary data suggest that fish populations are less affected by acidification in Florida lakes than in temperate lakes. The relatively low concentrations of aluminum found in acidic Florida lakes may explain this difference.

064983
CRISMAN TL, BREZONIK PL * **Acid rain: threat to sensitive aquatic ecosystems** , IN: Proc 73rd Annu Meet Air Pollut Control Assoc, Montreal, Que, 22-27 June 1980 * v2 22p * (1980).

The effects of acid precipitation on sensitive (softwater) temperate lakes are reviewed, and comparative results are presented on 20 warm temperate/subtropical lakes in Florida. Results indicate a lowering of pH, a loss of alkalinity, and an increase in sulfate in softwater lakes of northern Florida over the past 25 years, whereas a group of softwater lakes in south central Florida (near the present southern boundary of acidic rain) has not become more acidic over this period. Average chlorophyll a levels decreased with decreasing pH in the 20 lakes; the trend was not wholly explained by a similar trend between total phosphorus levels and pH. Phytoplankton populations changed markedly as a function of pH, with green algae replacing blue-greens and a general reduction in both biomass and species richness in acidic lakes. More subtle effects were seen for zooplankton and benthic invertebrate communities; nonetheless distinct differences were observed between acidic lakes (pH less than 5.5) and nonacidic lakes. Preliminary data suggest that fish populations are less affected by acidification in Florida lakes than in temperate lakes. The relatively low concentrations of aluminum found in acidic Florida lakes may explain this difference.

059307
CURTIS KE * **Emissions of acid-rain precursors in North America** * Ont Hydro Res Rev * (2) 5-10 * Ont Hydro, 800 Kipling Ave, Toronto, Ont M8Z 5S4 * 1981-05.

Precipitation falling over large areas of eastern North America is highly acidic, with sulphur and nitrogen compounds dominating this acidity. Current information was reviewed to identify the major sources of the precursors of acid rain in North America. A brief description is also given of the work done to characterize the emissions from Ontario Hydro's fossil-fuel-fired generating stations. Anthropogenic emissions of SO2 and NOx were found to exceed those from natural sources, having increased significantly since 1940. In Canada and Ontario, industrial processes and transportation are by far the major sources of SO2 and NOx, respectively. However, electric utilities are major emitters of both these acid gases in the United States.

067113
DILLON PJ * **Chemical alterations of surface waters by acidic deposition in Canada** * Water Qual Bull * 8(3) 127-132 * WHO Collaborating Cent on Surface and Ground Water Qual, Can Cent Inland Waters, Burlington, Ont * 1983-07.

The purpose of this paper is to outline the evidence available for assessing the current impacts of acidic deposition on aquatic ecosystems in Canada. Strong acids and strong acid precursors are deposited from the atmosphere by wet and dry processes on many lakes and streams and their catchments in eastern North America. The ability of an aquatic ecosystem to neutralize or assimilate acidic deposition and "buffer" chemical change must be considered with respect to time scale. In most parts of eastern Canada, acidic deposition accumulates in the snowpack during the winter. The interactions of the acidic deposition with the terrestrial ecosystem, including the vegetation, soil and bedrock, result in chemical alterations of the waters draining the watersheds, and eventually of the lakes downstream. In regions where the deposition of these acids exceeds 40 meq per sq m per year, there is considerable evidence of long-term increases in the SO concentrations of lakes and rivers, some evidence of long-term decreases in pH and acid neutralizing capacity (ANC), and some indirect evidence that cation concentrations have increased.

F11575
ENVIRON CAN * **Environnement Canada publiera des bulletins hebdomadaires sur l'acidite des precipatations** * 7p * Environ Can * 1983-12-06.

M. Charles Caccia, ministre de l'environnement, a annonce qu'Environnement Canada transmettra aux agences de presse des bulletins sur l'acidite de la pluie et de la neige, vers 14h00 tous les mardis, a compter du 13 decembre. Ces bulletins feront l'analyse de l'acidite des precipitations qui sont tombees a cinq endroits differents dans l'Est du Canada, au cours de la semaine precedente, en plus de decrire les deplacements des systemes meteorologiques a l'origine de ces precipitations. Les bulletins montreront que ce sont les systemes qui traversent les regions de l'Est du continent, ou les emissions de dioxyde de soufre sont fortes, qui provoquent les precipitations les plus acides. Pour plus de renseignements, communiquer avec H.C. Martin, Bur fed de liaison pour le TADPA, Environ Can, 4905 rue Dufferin, Downsview, Ont M3H 5T4

063210
ENVIRON CAN, DIR EAUX INTER, REG QUE * **Bibliographie precipitations acides** * 91p * Environ Can Inland Waters Dir, Que Reg * 1982-07.

This comprehensive bibliography on acid rain contains mainly citations in English. A section on reports and symposiums is followed by a listing of general publications. One section is devoted to the atmosphere including long range transport of air pollutants, atmospheric depositon, and monitoring. Several sections are related to aspects of the acidification of water: precipitation, chemistry, fish, plankton, invertebrates, fauna, soils, and vegetation. A final section contains a short list of bibliographies.

063868
FERLAND M, HULETT L * **Standardization of measurement and collection techniques** , IN: Proceedings, Symposium on Monitoring and Assessment of Airborne Pollutants with Special Emphasis on Long-Range Transport and Deposition of Acidic Materials and Workshop on Air and Precipitation Monitoring Networks, Ottawa, Canada, 30 August - 3 September 1982 * PIERCE RC, WHELPDALE DM, SHEFFER MG * NRCC 20642 * 453-456 * Natl Res Counc Can, Assoc Comm Sci Criteria, Ottawa, Ont K1A OR6 * 1983.

The need for standardization of networks involved in determining acid deposition, is discussed in this working group's report. It is shown to take two forms: all monitoring stations could be made uniform in terms of siting, instrumentation, and operation; or a system could be implemented to assess differences in the various monitoring networks. The implementation of a comprehensive classification system for each monitoring station is proposed by the working group to identify different procedures and techniques in the various networks. Other factors considered important by the working group include: the importance of giving complete, comprehensive site documentation; a few stations should be colocated in order to help establish the compatability of networks in regions where networks overlap; all monitoring station operators should be given adequate training in their duties; the need for research and development in several areas including improved techniques for both wet and dry deposition; more extensive nonurban monitoring networks; and, a central laboratory for producing standards.

066558
FLETT RJ * **Chemical, microbiological and physical interactions of acidic precipitation within a lake and its drainage basin** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

F11857
FOSTER NW, NICOLSON JA * **Interaction des precipitations acides et de la vegetation dans le bassin forestier du lac Turkey** * Rev rech du Serv can forets * 3(4) 36-38 * Environ Can, Serv can forets * 1983.

Les preoccupations au sujet des effets des pluies acides sur les forets et l'eau ont ranime l'interet pour l'alteration de la qualite des precipitations par les forets et les sols. Ce rapport examine les resultats provisoires d'une etude du cycle biogeochimique des elements dans une foret d'erable a sucre et de bouleau jaune. L'importance des modifications chimiques survenues dans les precipitations dans une foret feuillue de 140 ans au bassin forestier du lac Turkey a ete determinee par echantillonnage des precipitations totales, des precipitations au sol et du percolat de la couverture morte. Les resultats de cette etude sont presentes dans ce rapport.

062958
FOX J * **Acid rain, acid tears, From the Taj Mahal to Canada's North, acid rain scars the earth's face and poisons its waters** * Can Consum * 13(5) 7-12 * 1983-05.

An overview is given of the acid rain problem. The extent of acid rain effects in Canada are described as well as in several other parts of the world. Available emission abatement technology is discussed. The impacts of acidification on aquatic ecosystems and on soil systems are described. The effect of soil acidification on tree growth, a three-phase process, is also described. Examples are given of the environmental effects of acid rain in several regions of Canada and the origins of the acids involved are listed, with the INCO Ltd. smelter at Copper Cliff, Ontario being the single largest point source of SO2 emissions in the world. Abatement methods discussed include the use of low-sulphur fuels in thermal electric plants, flue gas desulphurization and the use of new burners

with limestone injection systems. However, these new technologies are expensive and industry has reservations about undertaking the extra expense. Emission control has been a poor economic policy, especially during times of recession. As acid rain currently endangers jobs in the tourism, forestry, and fishing industries, emission control can save jobs by protecting the natural resources upon which much of the economy depends. The effects of acid rain on sport fishing, on building deterioration and on health care costs are discussed. An insert accompanying this article discusses the political issues involved with acid rain.

064980
FRANTISAK F, PELLETIER GH, BEDARD M, CASTONGUAY G * **Precipitation quality in northwest Quebec-Canada** . IN: Proc 73rd Annu Meet Air Pollut Control Assoc, Montreal, Que, 22-27 June 1980 * v4 15p * (1980).

The transport and fate of sulfur and nitrogen compounds emitted into the atmosphere are very complex. Their concentrations and effects on the environment depend on many variables: emission levels, atmospheric transformation, dispersion and deposition. The removal of sulfur and nitrogen compounds from the atmosphere takes place by wet mechanisms such as rain, and dry deposition between precipitation events. An extensive dry and wet deposition survey has been conducted by Noranda Mines in northwestern Quebec since 1977. This paper reports data based on wet/dry composite and snow-core samples collected in 1978-79. Survey area covers 200,000 km in northwest Quebec. Precipitation samples were collected using an automated wet-dry sampler. Snow-core samples were collected with an aluminum coring device. Ion chromatography was used for determination of sulfates and nitrates. Annual average sulfate concentration in precipitation of 2.64 ppm has been measured at Matagami, northwest Quebec. This represents 1.9 kg of S/ha/year. There is significant annual variation of SO4 and NO3 concentrations in precipitation. However the SO4/NO3 ratio remains constant, which suggests that the sources of sulfur and nitrogen oxides are the same or located in the same area.

062621
FRASER WW * **Transboundary pollution** , IN: Environmental Government Affairs Seminar, Proc, Environmental Concerns of the 80's, October 12-15, 1982, Ottawa, Ont * 248-254 * Air Pollut Control Assoc and Fed Assoc Can Environ * (1982).

This paper reviews the state of transboundary pollution from an industrial viewpoint. Under present law, the Federal authorities have a clear mandate where human health is concerned. Where health is not concerned, the provinces must play the lead role. In matters such as acid precipitation, when agreement cannot be achieved amongst the provinces, the federal government then becomes the arbitrator. The acid precipitation situation in relation to the United States is discussed briefly. It is suggested that both governments and industry must assist scientists by advising on areas of meaningful research. At present there is insufficient information of the science of acid precipitation and transboundary air pollution to move to regulation. All parties involved have a clear responsibility to deal honestly with the entire problem, to educate and inform the public and the policy makers and to co-operate with each other.

065379
FREDERICK ER (ED) * **A Specialty Conference on Atmospheric Deposition, November 7-10, 1982, Detroit, MI US** * 476p * Air Pollut Control Assoc, Pittsburgh, PA US * 1982.

These proceedings contain 32 papers presented in five sessions: critical reviews of the present status of information concerning atmospheric deposition sources, transport, effects, and cost benefits and control strategies; sources and monitoring; source receptor relationship; deposition and effects; and, cost-benefit analysis and control strategies. Critical reviews providing information on non-acidic deposition designated as organics and trace metals are also included. Recent work in the four major areas of concern - sources, transport, effects and control strategies - is described in many papers. Sources of acid rain and atmospheric deposition in the United States and Canada as well as precipitation measuring, data networks, and deposition monitoring, are covered. Source receptor relationships include papers on regional sulfur models of wet deposition. Effects of deposition on lakes, fisheries, food chains, agriculture and forestry are outlined. Control costs and strategies and benefits estimation are also discussed. A summary of the major conclusions reached in the various sessions is presented at the end of the proceedings.

063270
GIBSON R * **Acid rain as a political dilemma** * Alternatives * 11(2) 3-8 * Alternatives, c/o Trent Univ, Peterborough, Ont K9J 7B8 * 1983.

There is enough evidence to show that acid rain has caused widespread environmental damage, particularly to aquatic ecosystems, and that it threatens to cause much more. Unfortunately, governments must force those responsible for individual sources of acidifying emissions to carry out costly abatement programs. In each case, officials must decide whether to compel abatement, and how much, how quickly, and despite what costs. If individual decisions cannot be justified fully, then political challenges multiply. In this context, these characteristics of acid

rain are worrisome: acid rain and its effects are complex and ill-understood; there is no prospect that the uncertainties will be overcome; acid rain involves competing interests in separate, even distant jurisdictions; abatement options are unattractive to emittors and difficult for regulators to evaluate; and acid rain is linked with a host of other environmental abuses. What is lacking in the political responses to acid rain is a satisfactory basis for objective decisions about what priorities to assign to specific abatement needs, or how much abatement to require at individual sources. Political responses are: research, abatement requirements, and international negotiations. It remains important to seek reforms that would require polluters to prove their discharges are benign (rather than require victims or regulators to prove needs for abatement), to encourage public participation in abatement decision making, and to ensure more rigorous enforcement of environmental protection legislation.

064061
GILBERT G * **The ecosystem: how does it react?** * 3p * 1982.

An approach, used on the general concept of the ecosystem, is used to produce a map of the province of Quebec locating the areas sensitive to acid precipitation. The development of a multi-level integrated mapping procedure and applying one level, the ecodistrict, to the composite mapping of Quebec on a single sheet, is described. The ecodistrict map was prepared by synthesizing all the available information and using visual interpretation of Landsat imagery at a scale of 1:1,000,000, supported by a series of aerial photographs. Descriptions of high, medium and low buffering capacity are presented to explain changes in soil fertility and the acidity of lakes and watercourses. The sensitivity maps presented combine effects of various environmental factors and incorporate two types of evaluation: one covering the sensitivity of soils in terms of productivity; and the other the ability of the ecosystem to neutralize acidic water percolating through the soil. Nearly 1,000 units of terrain in Quebec are described, including factors such as relief, geomorphology, geology, present vegetation, climate and bodies of water.

064060
GILBERT R * **Measuring instruments** * 3p * Environ Can, PO Box 10,100, Ste-Foy, Que G1V 4H5 * 1982.

The expansion of the network of sampling stations across Canada to determine the acidity level of rain and to find out which regions were hardest hit is described. Included in this network are: the Canadian Network for Sampling Precipitations with 53 sampling stations recording monthly quantities of liquid and solid precipitations to determine the concentration of chemical substances causing the acidity of the precipitation; the 42 temporary stations installed to sample rain water and determine variations in the pH and sulphate content of rain at different locations; and, the 7 stations to analyze samples of liquid and solid precipitations. The emphasis in this discussion is on stations in Quebec. Brief reviews of the causes of acid precipitation, location of the sources of emission in Canada and the United States, and the characteristics and uses of long-range transport models, are also included.

065380
GILES JW * **Thinking globally, acting locally** . IN: A Specialty Conference on Atmospheric Deposition, November 7-10, 1982, Detroit, MI US * FREDERICK ER * 3-11 * Air Pollut Control Assoc, Pittsburgh, PA US * 1982.

Long-range transport of air borne pollutants is seen as a global problem with solutions which must be developed locally. The subject is considered under the following questions: what do we know; what have we done about it so far; what are the obstacles to the solution; what are our commitments; and, what are the prospects for success. Scientific conclusions on the global extent of the problem, are discussed. Progress made in North America, including the signing of a 1980 Memorandum of Intent to reduce air pollution sources as well as progress made in other parts of the world, are examined. Obstacles to progress are seen as the current economic situation, potential unemployment in the resource industry and a lack of conviction that the problem does exist and should be corrected. Current Canadian commitment to protect the environment is described with the emphasis on the need for United States cooperation. Immediate global action to take corrective measures to reduce emissions is seen as necessary, with the belief that economic recovery would bring a favourable climate for positive action.

065553
GLASS GE, BRYDGES TG * **Problem complexity in predicting impacts from altered precipitation chemistry** , IN: Acid rain/fisheries, Proc Int Symp on Acidic Precipitation and Fishery Impacts in Northeastern North America, Ithaca, NY, 2-5 Aug 1981 * HAINES TA(chairman) * 265-286 * Am Fish Soc, Northeast Div, 5410 Grosvenor Lane, Bethesda, MD 20814 US * 1982.

Prevailing weather conditions in North America foster large-scale movement of air masses containing pollutants, resulting in depositions in regions far removed from the sources. Pollutants transported through the atmosphere are removed by wet and dry processes. The ultimate fate of pollutants

depends on many factors, including meteorology and pollutant characteristics. The prevailing winds are westerly, but this pattern is complicated by seasonal trends. Long distance transport of pollutants is facilitated by tall smoke stacks, high winds, and a stable lower atmosphere which allows the plume to remain intact. Absence of precipitation increases airborne residence time and thus the distance of transport. Sulfur and nitrogen compounds are emitted as oxides from combustion and smelting, which react chemically in the atmosphere to form sulfuric and nitric acids. Natural contributions to atmospheric pollutant loading are soil erosion, volcanoes, and natural gases (ammonia and hydrogen sulfide) from decomposition of vegetation. Oceans contribute sodium and chlorine as well as potassium, magnesium and calcium. The acidity and chemical composition of surface and ground waters, due to altered precipitation chemistry, is controlled by atmospheric loading, total acidification intensity of precipitation, and total buffering capacity of the watershed. Extensive empirical observations, supported by 4 models, have been used to provide target loadings for acid precipitation in North America. Research is required to define the interrelationships among the ecosystem components, and the extent of pollutant alteration to the natural hydrocycle. Irreversible changes occurring over significant areas in North America are of great concern. Reductions in acidic deposition to loadings of SO4 ions to 10-20 kg/ha/yr are required to protect and perhaps restore the most sensitive aquatic systems in the eastern regions.

063862
GRANAT L * **Siting criteria** , IN: Proceedings, Symposium on Monitoring and Assessment of Airborne Pollutants with Special Emphasis on Long-Range Transport and Deposition of Acidic Materials and Workshop on Air and Precipitation Monitoring Networks, Ottawa, Canada, 30 August - 3 September 1982 * PIERCE RC, WHELPDALE DM, SHEFFER MG * NRCC 20642 * 281-314 * Natl Res Counc Can, Assoc Comm Sci Criteria Environ Qual, Ottawa, ONt K1A OR6 * 1983.

Regional investigations of air and precipitation chemistry require proper sampling sites. This report concerns the relevant factors for the selection of sites in large-scale networks, where sampling stations are 100-500 km apart. Such networks serve to reveal only large-scale concentration and/or deposition fields. Thus, the interpretation is limited to components with residence times in the atmosphere of at least 1 d and it is assumed that the measurements are made some distance from major sources.

062618
GRENVILLE-WOOD G * **Statement of Geoffrey Grenville-Wood, vice-president Environmental Mediation International to the Environmental Government Affairs Seminar "Environmental Concerns of the Eighties", Ottawa, Ontario, October 14, 1982** , IN: Environmental Government Affairs Seminar, Proc, Environmental Concerns of the 80's, October 12-15, 1982, Ottawa, Ont * 273-286 * Air Pollut Control Assoc and Fed Assoc Can Environ * 1982-10-14.

This paper outlines problem areas in the negotiations between Canada and the United States regarding acid precipitation. The Environmental Mediation International (EMI), a non-profit organization that seeks to act as neutrals in the settlement of international, transnational and domestic environmental disputes, suggest solutions in these areas. Differences in approach to the acid rain problem by Canada and the United States arise in the following areas: (1) belief in the good faith of the parties to the negotiations, (2) agreement on the scientific data base that the parties can use to further the negotiations, (3) the understanding that each party has of the other's constitutional, political and legal systems and (4) the apparent absence of a common interest in achieving an acceptable solution, in the short or medium term. The Environmental Mediation International presents three suggestions to assist in proceeding with negotiations despite the present political impasse. Negotiations have reached a stage that may require the application of some dispute resolution techniques. EMI suggests the use of a neutral third party, to gather information, to prepare discussion drafts, and to reconcile objective differences in scientific data in order to assist in preparing the way for the principal negotiators to deal with the political issues which require decision making at the political level.

F11695
GROUPE DE TRAV ETATS-UNIS CAN * **Memorandum declaratif d'intention concernant la pollution atmospherique transfrontiere, evaluation des repercussions, rapport provisoire** * Pd * Groupe de trav Etats-Unis/Can * 1981-02.

Un des grands objectifs de ce rapport est de decrire l'etat des connaissances concernant les effets de la pollution atmospherique produite outre-frontiere dans chacun des quatre domaines affectes: systemes aquatiques, systemes terrestres, structures artificielles et sante humaine et transparence atmospherique. Le rapport fournit d'abord un cadre descriptif pour mieux comprendre le probleme. Ensuite, pour chacun des quatre domaines affectes, le rapport decrit les principaux effets physiques et biologiques documentes du transport a distance des polluants, en particulier les effets des pluies acides. Il presente les methodes de

definition des zones sensibles, decrit les effets des apports atmospheriques en fonction du temps, s'efforce de fixer des objectifs de reduction des apports, en particulier par les pluies acides, et enumere les besoins de recherche pour faire progresser la connaissance scientifique du probleme.

F11696
GROUPE DE TRAV ETATS-UNIS/CAN * **Memorandum declaratif d'intention concernant la pollution atmospherique transfrontiere, rapport provisoire** * 189p * Groupe de trav Etats-Unis/Can * 1981-02.

Ce rapport fait partie d'un groupe de quatre rapports qui representent l'effort initial pour rassembler toute l'information disponible sur la pollution atmospherique transfrontiere, tout en mettant en relief les depots acides, et pour en arriver a un consensus sur la nature du probleme et sur les moyens a prendre pour le traiter. Les principaux volets traites sont: 1) l'elaboration de strategies: revue des pratiques et principes internationaux qui ont cours, hypotheses des scenarios de base 2) la coordination des recherches, des reseaux de surveillance et entre les groupes de travail 3) les activites des groupes de travail de la phase II, c'est-a-dire connaissance du phenomene relie a ce type de pollution.

F11226
GROUPES DE TRAVAIL * **Etats-Unis - Canada, Memorandum declaratif d'intention concernant la pollution atmospherique transfrontiere, sommaire des rapports des groupes de travail** * pd * Groupe travail * 1983-02.

Les depots secs et humides de substances acides et autres polluants constituent actuellement un phenomene repandu dans la plus grande partie de l'est de l'Amerique du Nord. C'est au groupe de travail sur l'evaluation des effets qu'il incombait d'identifier et d'evaluer les principales consequences physiques et biologiques decoulant eventuellement des deplacements de ces agents de pollution atmospherique. Le groupe de travail a juge necessaire de suivre une demarche tres structuree pour evaluer ces effets et a donc decide de presenter les resultats obtenus par type de repercussions (a savoir sur les milieux aquatiques, terrestres, etc.). Toutefois, bien qu'elle se soit averee tres pratique pour classer et presenter les conclusions auxquelles le groupe est parvenu, cette methode comporte neanmoins ses limites dans la mesure ou elle ne permet guere d'evaluer les interactions entre les differents types de repercussions, qui ne se produisent jamais de facon isolee. Le groupe de travail a donc resume les resultats obtenus dans les paragraphes suivants, qui traitent des effets sur les milieux terrestres et aquatiques de la biosphere, ainsi que sur la sante, la transparence de l'air et les structures artificielles. Il donne en outre des precisions sur la methodologie utilisee pour evaluer les avantages economiques lies aux mesures anti-pollution, ainsi que sur l'inventaire des ressources tant naturelles que materielles et sur le chaulage.

O65552
HAINES TA (CHAIRMAN) * **Acid rain/fisheries, Proceedings of an international symposium on acidic precipitation and fishery impacts in northeastern North America, Cornell University, Ithaca, New York, August 2-5, 1981** * 357p * Am Fish Soc, Northeast Div, 5410 Grosvenor Lane, Bethesda, MD 20814 US * 1982.

The keynote address at this symposium was on "Acid rain, environmental crisis of the eighties". Papers were presented on: case histories in Canada and United States; geochemistry; impacts on decomposers, plants, invertebrates and amphibians; prognosis and remedial action; socio-economic concerns; and acid rain and international law. Abstracts are given of the poster sessions. This volume should contribute significantly to our understanding of acidic precipitation, identify future research needs, and contribute constructively to the debate about the actions needed to deal with this international problem.

O63861
HICKS BB * **Measurement techniques: dry deposition** . IN: Proceedings, Symposium on Monitoring and Assessment of Airborne Pollutants with Special Emphasis on Long-Range Transport and Deposition of Acidic Materials and Workshop on Air and Precipitation Monitoring Networks, Ottawa, Canada, 30 August - 3 September 1982 * PIERCE RC, WHELPDALE DM, SHEFFER MG * NRCC 20642 * 245-269 * Natl Res Counc Can, Assoc Comm Sci Criteria, Ottawa, Ont K1A OR6 * 1983.

Dry deposition measurement methods are discussed in the perspective of historical dustfall and deposit gauge techniques. The deficiencies of bucket and funnel measurements of dry deposition of small particles are likened to those of micrometeorological evaporation pans, and the development of alternative methods of measurement extends the similarity further. A range of techniques is discussed, with emphasis on gradient and covariance micrometeorological methods and on ways in which concentration measurements can be used to infer deposition rates.

O63867
HIDY GM * **Optimization of existing networks** . IN: Proceedings, Symposium on Monitoring and Assessment of Airborne Pollutants with Special Emphasis on Long-Range Transport and Deposition of Acidic Materials and Workshop on Air and Precipitation Monitoring Networks, Ottawa, Canada, 30 August - 3 September 1982 *

PIERCE RC, WHELPDALE DM, SHEFFER MG * NRCC 20642 * 413-435 * Natl Res Counc Can, Assoc Comm Sci Criteria Environ Qual, Ottawa, Ont K1A OR6 * 1983.

This paper contains several observations about the approach to optimizing the air monitoring and precipitation chemistry networks in North America for the 1980's. Some guiding principles for organizing an effective monitoring system are offered. Recommendations are given to rationalize the networks for their value in elucidating critical technical issues about atmospheric processes resulting in (i) the deposition of acidifying substances; (ii) the apparent spread of photochemical oxidant; and (iii) widespread production of visibility-obscuring haze. Key ingredients of the measurement system are discussed, including instrumentation requirements, station siting, quality control and assurance, and data management. Effective surveillance of regional -scale atmospheric processes will require both ground-level and aircraft monitoring. The vitality of the monitoring program will depend on continued stimulation of data use to address issues of causes and effects of air contamination. Because of the heavy resource requirements involved, a joint, long-term Canada - United States commitment is proposed as appropriate for underwriting the program.

063268
HOLDSWORTH JD * **Historical trends in precipitation chemistry in eastern North America, Part 1** * Ont Hydro Res Rev * (2) 39-41 * Ont Hydro, 800 Kipling Ave, Toronto, Ont M8Z 5S4 * 1981-05.

Annual precipitation data were abstracted from the literature and examined for historical trends in chemical composition. Acidic precipitation (pH is less than 5.6) has been observed at some locations in northeastern North America over the last 25 years. Annual average values of pH, log ($SO_4^=$) and log (NO_3^-) were compared on a year to year basis by the t-test for the entire region. Some significant differences were found in these comparisons. However, linear regression analysis yielded no statistically significant linear trend in the period 1955 to 1979. An alternative analysis, restricted to pH data and involving sub-regional comparisons is presented in Part 2 of this article.

067122
JACOBSON JS, TROIANO JJ * **Dose-response functions for effects of acidic precipitation on vegetation** (see chapter 5.2 for complete reference - voir chapitre 5.2 pour la reference complete)

065557
JOHNSON MG * **Acid rain and fisheries - an overview** , IN: Acid rain/fisheries, Proc Int Symp on Acidic Precipitation and Fishery Impacts in Northeastern North America, Ithaca, NY, 2-5 Aug 1981 * HAINES TA (chairman) * 329-339 * Am Fish Soc, Northeast Div, 5410 Grosvenor Lane, Bethesda, MD 20814 US * 1982.

Nearly 60 million fishermen, almost one-quarter of Canadians and Americans, spend $18 billion annually on lodging, transportation, equipment, supplies and services. Nearly 20 million anglers spent close to $4 billion fishing for several species of trout, char and salmon in freshwaters. Presumably much of this was expended on lakes and streams threatened or damaged by airborne pollution. Widescale expansion of the power industry during the 1950s was followed by a significant increase in mineral acids in precipitation downwind from the industrial heartland of the continent, that is, in northeastern United States and eastern Canada. In terms of H^+ loading, southeastern Canada receives 50-100mg per sq m per yr and the northeastern U.S. receives 40-80 mg per sq m per yr compared with 5 mg per sq m per yr in remote continental areas. Southern Scandinavia receives 25-90 mg per sq m per yr. The Achilles Heel of oligotrophic lakes is lack of buffering and sensitivity to pH depression with related increase in mobility and toxicity of heavy metals and decrease in mineralization and availability of important nutrients like phosphorus and carbon. The threshold for most toxicological effects on a variety of fish species, pH 5.0 to 5.5 corresponds to the pH at which many natural populations of fish showed a high rate of extinction and to the pH immediately below the point of inflection of solubility of aluminum. Damaged fisheries have been well documented in the Adirondacks of New York, brook trout lakes of Laurentides Park in Quebec, Nova Scotia salmon rivers and the Killarney, Haliburton and Muskoka lake districts of Ontario. Food chain effects are very complex but declines in productivity of many lakes could be one insidious effect of acidification; another effect is the acceleration of mercury contamination of fish. Loss of genetic stocks of fish may jeopardize rehabilitation efforts. General models of sensitivity of lakes and streams are an important part of the argument to save threatened fisheries. Investigators will strengthen existing models on an international basis, as certain well-known lakes become yardsticks of acidification damage. Remedial programs will be staged, commencing with pollutant removal at lowest marginal cost, and will be iterative, as the understanding of effects and remedial technology continually improves to aid in fine-tuning. However, to secure the commitment to a longterm program, environmental protection policy needs to be rationalized in order to deal satisfactorily with large-scale issues. It is important that all members of the fisheries community work

together to make resources planning and management a cornerstone in environmental protection, and to support such a framework with broader and stronger social and economic arguments.

065809
JOHNSTON DM, FINKLE P • **Acid precipitation in North America: the case for transboundary cooperation** • 75p • Can Inst Resour Law, Univ Calgary, Calgary, Alta T2N 1N4 • 1983.

The transboundary character of acid pollution is the principle focus of this analysis of the effectiveness of alternative legal approaches to the acid rain problem in North America. Issues and techniques involved in the control of acid precipitation in North America are reviewed and the legal and institutional approaches to environmental control strategies are discussed. The history of private environmental litigation is reviewed briefly in an attempt to explain the attitudes of lawyers and policymakers involved in devising an effective North American air pollution control strategy and the subject of public health litigation is examined. A discussion of national air quality management considers the legislative approaches of the United Kingdom, The United States and Canada. The general principles of international law are discussed in relation to an international control strategy for acid precipitation and the history and importance of bilateral boundary treaty agreements are examined and discussed. Regional initiatives in Europe with regard to the problem are briefly described and Canadian and American attempts at establishing an appropriate policy to control long-range transboundary pollution are reviewed. As a conclusion, suggestions are put forth for consideration in the negotiation of a Canada - United States transboundary air pollution agreement.

062386
JOSHI SR • **Airborne radioactive materials and plants: a review** • Sci Total Environ • v24 101-117 • 1982.

Airborne radioactive materials readily contaminate plant surfaces and thus are incorporated into the food chains. Most of the nuclear fission products and naturally occurring radionuclides in the air are carried on solid particles ranging in size from a few submicrons to several millimetres in diameter. Of many available mechanisms, rainfall plays a dominant role in the deposition and removal of radioactive particles from plants. Mechanisms for the deposition of submicron particles, which carry significant amounts of radioactivity, are still not very well understood. Available information on the physicochemical aspects of the retention of radionuclides by plants is inadequate in explaining radionuclide uptake and desorbability. Much of the work reported so far has been carried out on selected fission products only. There is a dearth of data pertaining to naturally occurring radionuclides, especially 222Rn and its daughters, significant amounts of which are released to the environment during uranium mining and milling operations. Radiation damage in plants is difficult to detect except at levels of contamination thousands of times higher than those attained in most real life situations. Existing reports give conflicting accounts of the damage induced by low-level radiation in plants. The literature data discussed in this review are presented as basic information needed for the conduct and interpretation of useful research.

067155
KENDARIS TA • **Acid rain, a survey of selected headwater lakes in Newfoundland** • 121p • Dep Fish Oceans, Res Resour Serv Div, St John's, Nfld • 1981-12.

Dobrocky Seatech (Nfld.) Limited was awarded a contract to obtain a reference source of data from selected headwater lakes in Newfoundland, against which future potential changes resulting from acid precipitation could be monitored. Samples of lake water, plankton, benthos and fish were collected according to standard procedures established for the National Long Range Transport of Air Pollutants (LRTAP) program. Over the two-month field sampling program (20 August - 18 October, 1981) personnel and equipment were transported by air to 115 pre-determined lakes. From each lake a temperature profile was obtained using a digital thermistor unit. Simulataneous recordings of Secchi disc visibility were made. For accurate determinations of mean depth and other morphological variables, ten lakes were sounded by carrying out point-to-point line surveys.

067154
KENDARIS TA • **An acid rain inventory survey of selected Labrador lakes** • 124p • 1982-12.

Dobrocky Seatech (Nfld.) Ltd. was requested to undertake a survey to obtain background environmental and fisheries data from selected lakes in Labrador. Field sampling of 95 pre-selected lakes for surface water quality, plankton and fish populations, as well as 35 lakes for surface water samples only, was undertaken from 16 August to 20 October 1982. All intensively sampled lakes were initially sounded for mean depth and volume calculations by conducting representative transects. A vertical profile of temperature-dissolved oxygen was obtained at maximum lake depth, together with a simultaneous recording of Secchi disc penetration. Discrete water samples were collected for the field determination of pH, alkalinity, conductivity and free carbon dioxide.

064989
KING DR * **Acid rain as a foreign policy issue** , IN: Proc 73rd Annu Meet Air Pollut Control Assoc, Montreal, Que, 22-27 June 1980 * v2 5p * (1980).

In 1972, at the UN Conference on the Human Environment, held at Stockholm, the governments of industrialized countries first saw the need for coordinated action to address problems such as ocean and air pollution and the depletion of wildlife habitats. First indications of transboundary acid rain pollution were identified in Scandinavia. Eastern European countries, not OECD members, were also contributing to the acid rain problem in Europe, and they called for a Conference on the Environment under the terms of the Helsinki Accords. The venue moved from the OECD to the Economic Commission for Europe (ECE). It was agreed that regular reviews were to be held, and as evidence emerged, control measures would be considered. Canada and United States had signed the ECE Convention, but were looking toward a bilateral agreement of their own. We know acid rain can cause serious damage and is expensive to control. Both countries need to reduce their dependence on oil. In the developing countries, acid deposition is caused by high sulfur coals and lignite being used for cooking and heating, and by industrial development.

064555
KOCI R, RAYMOND A * **Acid rain, bright spots show on the dark cloud** * Legacy * 11(4) 14-17 * Ont Minist Environ, Commun Branch, 135 St Clair Ave West, Toronto, Ont M4V 1P5 * 1983.

Walter Giles, associate deputy minister responsible for the Intergovernmental Relations and Strategic Projects Division of Environment Ontario, said in an interview with Legacy: "There are indications that the attitude toward acid rain is changing even among the nations that have up to now been considered as principal generators of acid rain." Nearly 100 US journalists and politicians visited, as guests of the Canadian and Ontario governments, areas affected by acid rain and Environment Ontario's research facilities. The US media dealt with the subject in numerous publications, radio, and TV broadcasts. Reports were printed in National Geographic, Time and Newsweek. As a result, the US public is better informed than ever before, and is starting to realize that its own environment is being affected by acid rain. The Ontario Ministry of the Environment, the Federal Republic of Germany and Environment Canada are developing a next-generation computer model to trace the transport and deposition of acidic pollutants and oxidants, to be completed by 1986. With this model we will be able to identify sources of acidic deposition. This additional information will prove that the acid rain problem can only be solved in cooperation with our neighbours. Dr Tom Brydges, coordinator of the Acidic Precipitation in Ontario Study, says that the prognosis for Ontario lakes is not good, and the better understanding and the willingness of our neighbours to get involved in a solution of the acid rain problem is vital.

062994
KRAUS J * **Legal approaches to the control of acid rain** * Alternatives * 11(2) 25-34 * Alternatives, c/o Trent Univ, Peterborough, Ont K7J 7B8 * 1983.

This paper discusses American private and legislative remedies for control of acid rain, international law approaches, and the political pressure that will have to be exerted by fishermen and all of us if we are to restrict acid rain. As a matter of pure tort law, acid rain constitutes a "nuisance". In nuisance actions it is necessary to establish: a duty of care owed to the injured party; intentional or negligent breach of that duty of care; that the injury was directly caused by failure of defendant to conform to the duty of care; and the extent and specific amount of loss sustained. Further, the mechanics of bringing an interstate, interprovince or international lawsuit also presents difficulties of strategy and organization. The International Joint Commission (IJC), known for its efforts in reducing Great Lakes water pollution, is a model for an international agreement and regulatory body for acid rain. The impediments to international resolution are not legal. For a start the IJC, or its structure, could be applied to acid rain pollution and used to disregard boundary lines in much the same manner that the Nordic Convention has done for Scandinavia. Article X of IJC's founding treaty could be used to deal with private claims.

063686
KURTZ J, SCHEIDER WA * **Acidic precipitation in south-central Ontario: analysis of source regions using air parcel trajectories** * 20p * Ont Minist Environ * 1980-05.

Measurements of precipitation pH, SO4(sup-2) and NO3(sup-) were taken from August 1976 to April 1979 in the Muskoka-Haliburton region of Ontario. Sea level geostrophic trajectories were used to follow the air mass associated with the event back 48 hours to its 'octant of origin'. Two types of data analysis were carried out, one using the entire data set (composite analysis) and one using only precipitation samples consisting of a single event (event analysis). Concentrations of H+, SO4(sup-2) and NO3(sup-) in event samples from the S, SW, W and NW octants were high. Results from the entire data set showed that precipitation events most commonly occurred with trajectories from the S and SW octants. Both event and composite

analyses demonstrated that the majority of H+, SO4(sup-2) and NO3(sup-) deposited at Muskoka-Haliburton was associated with trajectories from the S and SW octants.

064424
LEWIS JE, MOORE TR, ENRIGHT NJ * **Spatial-temporal variations in snowfall chemistry in the Montreal region** * Water Air Soil Pollut * 20(1) 7-22 * 1983-07.

Snowfall was collected on an event basis for 6 winter storms in 1980 at 10 locations around the greater Montreal region. Six sites were urban, 2 suburban and 2 rural (small town). For all storms, 4 of the urban stations had the highest pH of the 10 locations, with the 6 Montreal Island sites having the highest chemical concentrations. Employing principal component analysis, two chemical species associations are apparent: (1) an alkaline/fly ash factor and (2) an 'acid snow' factor. The former indicates the possible effects of local emissions. Generally, the storms produced individual chemical concentrations patterns enabling five of the storms to be separated into distinct events. Three storms were designated as 'type' storms in which pH, sulphates, and nitrates varied according to individual storm characteristics and air trajectories. If the air trajectory passed over SO sub x and NO sub x sources to the west and south-west (Ontario - Great Lakes region) pH values were lower and sulphate and nitrate concentrations in the snowfall higher.

063684
LINZON SN (ED) * **An annotated bibliography, terrestrial effects of acidic precipitation** * APIOS Rep No 003/81, ARB 15-81-PHYTO * 181p * Phytotoxicol Sec, Air Resour Branch, 880 Bay St, 3rd Floor, Ont Minist Environ, Toronto, Ont M5S 1Z8 * 1981.

This bibliography is annotated, that is, in addition to listing the available literature, the information provided in each article is summarized and reviewed. The articles are grouped into main divisions, as effects on vegetation and effects on soils, and further subdivided into theme topics, with the articles listed alphabetically by authors in each subgroup. Further, this bibliography excludes papers dealing with the precursor pollutants as sulphur dioxide and nitrogen oxides alone unless there is direct reference to their contribution to acidic precipitation and effects on terrestrial systems. Those articles dealing with aquatic effects alone are not referred to in this bibliography. The literature on terrestrial effects of acidic precipitation available to us by the end of 1980 are included in this bibliography. It is anticipated that supplements will be produced from time to time. A copy of every paper listed in this bibliography is stored in the Terrestrial Effects Working Group reference file located on the third floor at 880 Bay Street, Toronto. The purpose of assembling the available literature on terrestrial effects is to lay the foundation for future work and to make available to the reader the present state of knowledge in this highly important area of research.

066995
LUCYK C * **Determination of the economic significance of acid deposition effects, Ontario's program of socio-economic studies** . IN: Acid deposition, knowns and unknowns: the Canadian perspective, Proc, Montreal, Que, 7-8 Apr 1981 * 20p * APCA(Air Pollut Control Assoc) (Ontario/Quebec) and Fed/Prov LRTAP Sci Comm * (1981).

The purpose of this paper is to present the socio-economic studies now underway in Ontario to determine the economic significance of long range transport to air pollutants (LRTAP). These studies are a critical link to the development of policies, transforming the basic scientific evidence of physical effects into terms which draw out its economic dimensions. To date specific focus has been on the methodologies to value the aquatic based tourism and recreation sector, environmental quality, and the potential losses of crops, forest resources, buildings and structures.

062377
LUM KR, BETTERIDGE JS, MACDONALD RR * **The potential availability of P, Al, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb and Zn in urban particulate matter** * Environ Technol Lett * v3 57-62 * 1982.

NBS urban particulate matter, SRM 1648, has been analyzed by a sequential extraction procedure to determine the chemical forms of P, Al, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb and Zn. High proportions of P, Cd, Co, Cu, Ni, Pb and Zn were found to be in soluble and/or exchangeable forms which are potentially readily bioavailable.

063859
LUSIS MA * **Measurement techniques for acidic airborne constituents** . IN: Proceedings, Symposium on Monitoring and Assessment of Airborne Pollutants with Special Emphasis on Long-Range Transport and Deposition of Acidic Materials and Workshop on Air and Precipitation Monitoring Networks, Ottawa, Canada, 30 August - 3 September 1982 * PIERCE RC, WHELPDALE DM, SHEFFER MG * NRCC 20642 * 189-218 * Natl Res Counc Can, Assoc Comm Sci Criteria Environ Qual, Ottawa, Ont K1A OR6 * 1983.

This paper deals with the monitoring of those airborne constituents currently thought to be the most important contributors to acidic deposition, either wet or dry. Of particular interest are sulfur dioxide and

sulfates (including sulfuric acid); the nitrogen oxides (NO2 and NO) and nitrates (including nitric acid); and peroxyacetyl nitrate (PAN), which can make up a significant portion of the atmospheric nitrogen compounds downwind of polluted areas, and which, on dissolving in water droplets, may be converted to nitric acid. Ammonia is also included as an important neutralizing gas, information about which can aid in the interpretation of data on atmospheric acidity. The monitoring of the above substances is necessary primarily for two reasons: first, to interpret acidic deposition episodes and long-term patterns in acidic deposition; and second, to estimate dry deposition rates from ambient concentrations - the technique currently recommended for routine use. This latter aspect is very important, since wet and dry deposition are of comparable importance in eastern North America, yet air measurements, from which dry deposition rates can be inferred, are badly lacking. Only techniques either already available, or having potential, for routine monitoring will be discussed. Research methods capable of generating the required information of a "special studies" basis, and requiring close attention from highly qualified scientists or technicians, will not be considered in the present survey.

066992
LUSIS MA, CHAN WH * **Acid deposition mechanisms and measurements** , IN: Acid deposition, knowns and unknowns: the Canadian perspective, Proc, Montreal, Que, 7-8 Apr 1981 * 25p * APCA (Air Pollut Control Assoc) (Ontario/Quebec) and Fed/Prov LRTAP Sci Comm * (1981).

This paper considers the physical and chemical mechanisms whereby pollutants are wet- and dry-deposited, and describes some of the parametrizations for wet and dry deposition, which have been used by mathematical modellers working on the long-range transport of air pollutants, with a special emphasis on the present uncertainty about the magnitude for these parameters. Some of the work currently underway in monitoring of deposition, and the preliminary results emerging from North American deposition monitoring activities, are described.

063465
MALLEY DF, FINDLAY DL, CHANG PSS * **Ecological effects of acid precipitation on zooplankton, Chapter 14** , IN: Acid precipitation, Effects on ecological systems * D'ITRI FM * 297-327 * Ann Arbor Sci Publ, Ann Arbor, MI 48106, US * 1982.

This paper suggests a number of factors which may be responsible for changes in zooplankton communities of lakes with acidification. Each factor is described using data from an experiment involving the artificial acidification of a Precambrian Shield Lake 223, and from the literature. An attempt is made to judge the relative importance of each factor. Lake 223 has been acidified from 1976 to 1980, during which time the average pH of the epilimnion was reduced from 6.79 to 5.37.

063858
MANSON AN * **Data needs - regulatory requirements** , IN: Proceedings, Symposium on Monitoring and Assessment of Airborne Pollutants with Special Emphasis on Long-Range Transport and Deposition of Acidic Materials and Workshop on Air and Precipitation Monitoring Networks, Ottawa, Canada, 30 August - 3 September 1982 * PIERCE RC, WHELPDALE DM, SHEFFER MG * NRCC 20642 * 167-176 * Natl Res Counc Can, Assoc Comm Sci Criteria Environ Qual, Ottawa, Ont K1A OR6 * 1983.

The regulator has two types of needs from atmospheric modelling: the legal requirements associated with the specific nature of some types of regulations, and the information requirements associated with policy-and decision-making on emission controls appropriate to solve environmental problems. The regulator's needs can be quite different in each case. Where regulations are written in terms of allowable ambient air concentration or deposition of pollutants, the modellers must explicitly state the parameters which must be included in the calculations and the manner in which the information specifying the parameters must be gathered and used in the model. All input to the model must be able to stand a vigorous legal test. Where regulations are written in terms of allowable emission levels, modelling information is required for policy- and decision-making purposes. While this test may be somewhat less rigorous, models must provide appropriate information, including analysis of the implications of the certainties and uncertainties of the parameters.

064985
MCBEAN GA * **Long-range transport and deposition of acidic substances across national boundaries** , IN: Proc 73rd Annu Meet Air Pollut Control Assoc, Montreal, Que, 22-27 June 1980 * v2 7p * (1980).

Evidence is accumulating that sulphur compounds and other pollutants are transported long distances and deposited far from their point of emission. The objective of this paper is to present some of the factors and evidence to demonstrate this long-range transport. The evidence presented is mainly for sulphur compounds. Factors determining the distance of pollutant transport include the characteristics of the emission (stack parameters, chemical and physical form), the prevailing meteorology, pollutant transformation, the presence of other pollutants, and topographical features. Sulphur is emitted mainly as gaseous SO2 and is converted slowly to sulphate aerosol.

Evidence is accumulating from modelling studies that transport between regions is significant. There are significant transboundary fluxes between Canada and the United States. Three to four times as much sulphur moves across the border from United States to Canada as in the opposite direction.

063869
MCDONNELL B, BALSILLIE D * **Quality assurance programs for Canadian networks** , IN: Proceedings, Symposium on Monitoring and Assessment of Airborne Pollutants with Special Emphasis on Long-Range Transport and Deposition of Acidic Materials and Workshop on Air and Precipitation Monitoring Networks, Ottawa, Canada, 30 August - 3 September 1982 * PIERCE RC, WHELPDALE DM SHEFFER MG * NRCC 20642 * 457-458 * Natl Res Counc Can, Assoc Comm Sci Criteria Environ Qual, Ottawa, Ont K1A OR6 * 1983.

The concepts of quality control and quality assurance are discussed and described in this working group's report, particularly as they relate to Canadian monitoring networks. It is recommended that each monitoring agency nominate a quality assurance coordinator, derive minimum acceptable quality assurance standards, and complete a written quality assurance plan by July 1, 1983. To oversee and coordinate this quality assurance activity, two main courses of action are recommended: employment of the Research and Monitoring Coordinating Committee Subgroup on Quality Assurance as the main vehicle for implementation; and, involvement of the National Research Council of Canada.

059308
MCMILLAN AC * **Long-range transport of atmospheric pollutants** * Ont Hydro Res Rev * (2) 11-19 * Ont Hydro, 800 Kipling Ave, Toronto, Ont M8Z 5S4 * 1981-05.

The meteorological factors affecting long-range transport of pollutants in the atmosphere are discussed. The literature describing the relation of meteorology to precipitation acidity is briefly surveyed and an example of an acid rain incident in eastern North America is presented. It is concluded that both large-scale flows and mesoscale features must be considered if the meteorological conditions leading to long-range transport are to be understood.

063864
MCQUAKER NR * **Quality control in analysis and reporting for acidic precipitation monitoring** , IN: Proceedings, Symposium on Monitoring and Assessment of Airborne Pollutants with Special Emphasis on Long-Range Transport and Deposition of Acidic Materials and Workshop on Air and Precipitation Monitoring Networks, Ottawa, Canada, 30 August - 3 September 1982 * PIERCE RC, WHELPDALE DM, SHEFFER MG * NRCC 20642 * 341-360 * Natl Res Counc Can, Assoc Comm Sci Criteria Environ Qual, Ottawa, Ont K1A OR6 * 1983.

A brief review of laboratory measurement techniques for precipitation samples is presented. These dilute, weakly buffered samples present ideal matrices for the determination of priority parameters such as SO4, NO3, Cl, NH4, Ca, Mg, Na, and K. This, however, does not extend to pH and acidity measurement where the weakly buffered situation that is so favorable to the foregoing analysis presents problems for conventional techniques. Errors introduced by streaming potentials and residual junction potentials limit the accuracy of conventional pH measurements. Conventional titrimetric determinations for acidity use arbitrary reference pH values which are of limited value in resolving contributions from strong and weak acidity. Recommended measurement techniques that demonstrate acceptable precision and accuracy are discussed, together with associated quality control requirements. Recommendations for approaches to be taken in Canadian network monitoring are made.

063408
MEHRA MC * **Measurement of lead, cadmium, arsenic and mercury in precipitation events** * Tech Bull No 127 * 15p * Inland Waters Dir, Atl Reg, Water Qual Branch, Environ Can, Moncton, NB * 1982.

This study describes concentrations of lead, cadmium, arsenic and mercury in wet precipitation samples collected at Moncton, New Brunswick. The sampling and analyses were done in the period June through November 1981. The volume-weighted averages for Pb, Cd, and As were found to be 5.28, 0.77 and 0.028 micro g/L, respectively. Mercury, however, was not detected in the samples. The data show that with increasing Pb levels, Cd and As levels also increase, and that Pb levels remain roughly 7 and 188 times greater than those of Cd and As.

059309
MELO OT * **Ontario Hydro's acid-rain monitoring network** * Ont Hydro Res Rev * (2) 29-37 * Ont Hydro, 800 Kipling Ave, Toronto, Ont M8Z 5S4 * 1981-05.

A great deal of concern about the health effects of sulphate aerosols surfaced in the mid-70's. As one of the emitters of the sulphur dioxide implicated in the formation of sulphate, Ontario Hdyro initiated a monitoring program in 1975 to establish facts about this little known pollutant. The monitoring effort has since been expanded to include precipitation chemistry measurements, in response to new concerns about the ecological effects of acid rain. Monitoring results are presented and discussed interms of influencing variables such as meteorology and sulphur dioxide source distribution, and compared with

information from other networks operating in northeastern North Amercia.

F11387
MERCIER A * **Menace pour l'environnement: les pluies acides** * Geoscope * 11(1) 55-73 * Dep geogr, Univ Ottawa, Ottawa, Ont * 1980-04.

L'article decrit le phenomene des pluies acides et leurs effets sur l'environnement, en proposant des solutions au probleme.

061918
MESSER T * **'Negative response' by U.S. stalls acid rain agreement** * Civic * 34(11) 8, 27 * Maclean Hunter Ltd, 481 University Ave, Toronto, Ont M5W 1A7 * 1982-11.

Ray Robinson of the Canadian Federal Environmental Assessment Review Office, speaking at the 7th symposium on statistics and the environment of the National Academy of Sciences in Washington, said that the Memorandum of Intent of 1980 showed clearly there is no basic disagreement between Canada and the United States on the acid rain issue. However, frustrated by the US Administration's changed attitude toward solving the problem, Canada is considering using the influence of the Internatinal Joint Commission (IJC) to monitor the implementation of an air quality agreement now under way, in the same way as the IJC is currently used to watch pollution on the Great Lakes. Not long after President Reagan took office it was realized that the rules of the game were being changed. A new term was coined - informational haze, and it is claimed that we do not know enough about acid rain to take action to control it. Canada is willing to reduce sulfur dioxide emissions by 50% during this decade, to achieve 20 kg wet sulfate loading per hectare per year, provided United States also does what is needed to meet this objective.

063032
ROBERTS J * **Opening address by the Honourable John Roberts, Minister of the Environment, Acid Rain and Forest Resources Conference, Quebec City, 14 June 1983** * 22p * Minist, Environ Can * 1983-06-14.

Canada's forestry sector produces $23 billion shipments annually, of which $13 billion is exports. In addition, forests provide the setting for the multi-billion dollar recreation and tourism industry, and have environmental value in regulating river flow, preventing soil erosion, and providing a home for wildlife. Policies of the Environment Ministry are formulated within the concept of "sustainable development". In forestry, the formula "annual allowable cut" depends on data on growth rates, insects, disease and fire loss, regenerative ability, accessibility, etc. In 1981 the downward revision of annual allowable cut levels was substantial enough to cause local shortages of wood. The Department has embarked on a strategy to strengthen the forest resource base. The Canadian Council of Resource and Environment Ministers (CCREM) has endorsed a 40% increase in harvest level by 2000, to be accomplished by encouraging changes in traditional attitudes to forest exploitation. The Federal Government is moving into direct support of forest renewal research and forestry schools. Issues which may influence the achievements of our forestry objectives include toxic chemicals, acid rain, energy, the land resource base and climatic change. Acid rain poses the most immediate threat. Studies show that 4,600 lakes are dead, and another 12,000 are moving towards the same condition. We must act to reduce acid deposition and pollution levels now, before damage becomes irreversible.

063646
ROBERTS J * **Royal Society review backs Canadian call for immediate control of acid rain** * 5p * Minist, Environ Can * 1983-07-27.

An independent review of acid rain reports, conducted by the Royal Society of Canada, concludes that scientific evidence is sufficient to warrant "the prompt introduction of abatement measures". Environment Minister John Roberts is pleased that this review supports the position the Canadian Government has taken in its discussions with United States. For more information, contact Brenda O'Connor, (819) 997-6555.

062972
MOROZ WJ * **Prediction of deposition of acid precursors** * Ont Hydro Res Rev * (2) 75-80 * Ont Hydro, 800 Kipling Ave, Toronto, Ont M8Z 5S4 * 1981-05.

Acidic deposition originates from sources ranging from exceptionally large - almost single-point emitters - to small, scattered, diffuse emitters distributed over the area of entire cities or regions. In these circumstances, numerical models are needed to quantify the deposition rates over receptors and to identify the significance of both individual and collective sources. Modelled calculations of this type indicate that Ontario Hydro's contribution to total acidic deposition in sensitive receptor areas in Ontario is relatively small.

063821
MOTLUK D * **Acid rain: a product of our industrial age** * Fish Bull * 21(2) 4-9 * Manitoba Dep Nat Resour * 1982.

Acid rain is precipitation with a pH level lower than 5.6 and occurs when sulfur dioxide and nitrogen oxide combine with cloud moisture to form solutions of sulfuric and nitric acid, which fall as acid rain or snow. There are strong links between high lake acidity and high amounts of toxic mercury in fish and wildlife. The symptoms of an acidifying lake

are an increase in moss and algae, the sudden appearance of dead fish, and the disappearance of frogs, tadpoles, salamanders, turtles and insects. Acidity also causes the release of aluminum from soils. Some species, such as perch and rock bass, can tolerate high levels of acid rain, whereas smallmouth bass, burbot and walleye are most sensitive to acidity. The most sensitive area in Canada is the Precambrian Shield. The prairies are the least sensitive, as the soil is rich in calcium carbonate and other buffers. Since weather patterns move from west to east, acid rain is not a problem in western Canada. The Great Lakes are not affected by acid rain because they are located in limestone bedrock. In Manitoba the primary sources of sulfur dioxide are: ore smelters, thermal generating stations, oil refineries, and pulp and paper plants. In 1980 monitoring stations were set up at Island Lake and Norway House to monitor SO2 levels drifting from smelters at Thompson and Flin Flon. Sampling of Manitoba rivers and lakes in the Precambrian Shield is underway. The permanent solution to acid rain is to keep acid levels low, by changing energy use patterns through conservation or the use of non-polluting sources and to stop emissions at the source.

063865
MUNN RE * **Principles of network design** . IN: Proceedings, Symposium on Monitoring and Assessment of Airborne Pollutants with Special Emphasis on Long-Range Transport and Deposition of Acidic Materials and Workshop on Air and Precipitation Monitoring Networks, Ottawa, Canada, 30 August - 3 September 1982 * PIERCE RC, WHELPDALE DM, SHEFFER MG * NRCC 20642 * 373-382 * Natl Res Counc Can, Assoc Comm Sci Criteria Environ Qual, Ottawa, Ont K1A OR6 * 1983.

The optimal design of a monitoring network depends on the following factors: (i) the objectives for monitoring; (ii) the tolerances permitted by the user with respect to meeting these objectives; (iii) the measurement errors expected, with respect not only to sensor performance but also to poor siting of monitoring stations; (iv) the spatial variability of the fields being monitored, in particular the degree of organization of the fields; (v) the time variability of the signals being monitored, in particular the extent to which a signal "remembers" its previous values; and (vi) practical considerations such as financial and manpower constraints. There are three general approaches to optimizing network design: (i) if a network already exists and if sufficient data have been collected, statistical tests can be applied to determine ways in which the network can be "fine tuned"; (ii) if the environmental processes being monitored are well understood, mathematical models can be used to determine the design that will best meet the performance standards set for the network; and (iii) best of all, if network data exist and if the environmental processes being monitored are well understood, a combined statistical-modelling approach can be used to optimize the network. These ideas are elaborated in the context of the long-range transport and deposition of acidic materials.

062996
MUNTON D * **Diplomacy under constraint: Life, liberty and the American pursuit of acid rain** * Alternatives * 11(2) 13-20 * Alternatives, c/o Trent Univ, Peterborough, Ont K7J 7B8 * 1983.

This article attempts to identify and discuss the major obstacles to acid rain control arising from United States. A fundamental fact of water pollution is that individual polluters benefit by 'washing' pollutants away. In addition, major source areas in United States are relatively unaffected by what acid rain they do receive. For example, the Ohio Valley has a substantial number of thermal power generating stations with emissions virtually uncontrolled, but the area is well buffered. Canada has a strong political interest in achieving a bilateral accord, but for United States there is no such strong interest. There is little basis for optimism concerning the bilateral negotiations on air quality. If there is any reason for greater optimism in the near future, it would rest in some clearly positive signs in American public opinion on acid rain, and political response to it. A congressional gutting of the Clean Air Act, feared by environmentalists, is unlikely. A tough new Clean Air Act with provisions for reductions of acid rain-causing emissions could provide the essential domestic statutory base for a bilateral commitment; it could not, however, force the administration to negotiate.

064976
NIEMANN BL * **An initial evaluation of transboundary transport of pollutants and wet deposition between the eastern United States and Canada** , IN: Proc 73rd Annu Meet Pollut Control Assoc, Montreal, Que, 22-27 June 1980 * V4 16p * (1980).

Satellites have a role to play in monitoring transboundary transport of pollutants on national and global scales, and in providing data to quantify the pollutants fluxes. The purpose of this paper is to provide an initial evaluation of the transboundary transport of sulfur dioxide and sulfates and the wet deposition of sulfates and nitrates, using meteorological, air quality, and precipitation chemistry data bases from both Canada and the U.S. The paper includes results on the frequency and magnitude of transboundary impacts and some simple regional model calculations of the relative magnitude of Canadian and U.S. annual sulfate impacts on one another. The

percentages of transboundary winds at 600 meters above ground are largest from eastern Michigan to western Ontario and from eastern Ontario to western New York. The most frequent direction for the sectors of extremely persistent surface winds over most of the Ohio River Basin, a major source region of SO2 emissions in the US, is toward the north. The maximum daily SO2 emissions cross Lake Erie by extremely persistent winds and appear to be about 150 micro g per cu m. US emissions produce sulfate concentrations in Ontario that are 6 times those produced by Canadian emissions, and sulfate concentrations in the upper Ohio River Basin about 12 times those produced by Canadian emissions.

066790
NS DEP ENVIRON * **Nova Scotia Department of the Environment submission to the sub-committee on acid rain of the standing committee on Fisheries and Forestry** * 20p * NS Dep Environ, Halifax, NS * 1981-04-13.

This submission consists of an overview of the current information available on acidic precipitation in Nova Scotia; the contribution of international, national and provincial sources to acid deposition in Nova Scotia; and, the contribution of Nova Scotia's activities to acid deposition in other jurisdictions. It is estimated that 52,000 tonnes of non-marine sulphur are deposited in Nova Scotia annually. Of this, 10,600 tonnes (20%), originate from within the province. In Nova Scotia it is difficult to determine the effects of acid deposition from acid drainage caused by excavation in pyritic bedrock. The effects of such acidification on lakes, terrestrial environments, human health, and buildings are reviewed. Studies and programs which provide the government with ways and means of developing control strategies and technologies are listed. It is concluded that more must be known about the economic and social impact of both acid deposition and proposed strategies before policy decision can be made by the Nova Scotia Government and those elsewhere.

059057
OLSON MP, VOLDNER EC, OIKAWA KK * **Transfer matrices from the AES-LRT model** , IN: Canadian Meteorological and Oceanographic Society, 16th Annual Congress, May 26-28, 1982, University of Ottawa, Ottawa, Ont * Atmos-Ocean * v20 p38 * 1982-05.

The AES Long-Range Transport Model has been used in the Canada-United States Memorandum of Intent program to compute transfer matrices in an attempt to quantify the source-receptor relationships between emission regions and selected receptor sites. Four-day backward trajectories were computed from the sites for the year 1978 at a height of about 600 m (925 mb). The Lagrangian concentration/deposition model computed sulphur concentrations and depositions at the 9 receptors using a seasonal emissions inventory with 15 Canadian and 25 United States emissions regions. The model used linear chemistry, dry deposition velocities, wet scavenging ratios and a numerical integration scheme using a trapezoidal rule formulation. The model was run using each emission region in turn to generate the elements of the 40 x 9 source-receptor matrices. The matrices show that the greatest impact on a receptor usually occurs from the emissions close to the receptor. In addition, the matrices show the ranking of decreasing impact from all emissions regions at all the receptors. Percentage contributions of each emission region at each receptor can be calculated as well as overall Canadian and U.S. percentage contributions. These matrices are a first attempt at linearly quantifying source-receptor relationships and still have unspecified uncertainties associated with them.

062095
ONT MINIST ENVIRON * **A submission to the United States Environmental Protection Agency hearings on interstate pollution abatement, Washington, D.C., June 19, 1981** * vp * Ont Minist Environ * 1981.

The document contains presentations made to a hearing panel of the United States Environmental Protection Agency in Washington, D.C. on June 19, 1981. The presentations aimed to illustrate the effects of transboundary pollution on the New York, Pennsylvania and Ontario regions. As well, they discussed Ontario's experiences in considering and controlling aggregated SO2 sources in relation to transboundary pollution and showed how Ontario has used long-range transport modelling in the consideration and control process. Ontario's Deputy Minister of the Environment, G.W.S. Scott gave an overview of Ontario's position with respect to the hearings and Bruce Terris commented on how the information in the hearing should be employed in rulemaking. Dr. E.W. Piche presented a brief description of how Ontario dynamically integrates policy and rulemaking with information gathering in regard to transboundary air pollution. Some case histories of transboundary air pollution were discussed by Lou Shenfeld, accompanied by meteorological data. Dr. T. Bridges commented on the use of lake studies in measuring atmospheric pollution, and Dr. G. Van Volkenburgh discussed the value of modelling in dealing with transboundary air pollution. Finally, Mr. G.W.S. Scott described how decision-making employs available evidence, including modelling and summarized the recommendations of the presentation.

063875
ONT MINIST ENVIRON * **Presentation to the Michigan Air Pollution Commission in opposition to the Detroit Edison request to delay bringing its Monroe power plant into compliance with the State of Michigan "1% or equivalent sulphur in fuel" rule, Monroe, MI, US, June 30, 1982** * 11ip * Ont Minist Environ * 1982-06-30.

This presentation outlines Ontario's position, in the request by the Detroit Edison company to delay bringing its Monroe power plant into compliance with the State of Michigan "1% or equivalent sulphur in fuel" rule, which is basically to support the enforcement of any regulation that would decrease the atmospheric burden of sulphur dioxide emissions. Ontario details its belief that the ultimate solution to the problem of environmental protection involves a reduction in emissions by all significant sources in all contributing jurisdictions. It points out that the action requested is in violation of the spirit and intent of the August 5, 1980, memorandum signed by Canada and the United States, which pledged to vigorously enforce existing laws and regulations to respond to the problems of transboundary air pollution. This presentation details legal and policy considerations, Ontario's LRTAP program (Long Range Transport of Air Pollutants), effects of acidic deposition on aquatic resources, and socio-economic implications.

062039
OUELLET M, JONES HG * **Paleolimnological evidence for the long-range atmospheric transport of acidic pollutants and heavy metals into the Province of Quebec, eastern Canada** * Can J Earth Sci * 20(1) 23-36 * 1983-01.

The present study deals with the geochemical stratigraphic evolution of the recent sediments of 26 lakes located throughout the Province of Quebec, Canada. Although there is no major anthropogenic activity within the watersheds of many of these lakes, it is shown that Pb, Zn, Hg, and Cu levels in the most recent sediments of all lakes increased significantly from 1940 onwards. It is suggested that these increases are due to the increased burning of fossil fuels (particularly coal). The heavy-metal increases tend to be relatively high, especially for Pb, Hg, and Zn, in the sediments of lakes from areas close to the U.S.A.-Quebec boundary, while lakes in more remote areas show smaller increases in the strata laid down in the same time periods. Pb contents in the sediments show a sustained increase in all of the upper strata. However, the subsequent reduction in the stratigraphic concentration of Zn and Hg since 1960 in both an acidified system (Lake Tantare) and a non-acidified lake (Lake Laflamme) might be the result of the important decrease of the total particulate emissions to the atmosphere associated with new technology for coal-fired power plants and the use of cleaner energy sources. The increase in Al in the sediments of Lake Tantare since 1950 is attributed to the processes of surface water acidification of this watershed induced by the long-range atmospheric transport of SO sub x and NO sub x. Based on the sedimentary anthropogenic enrichment factor (SAEF) values for the remote sites there is no evidence in the present study for associating the origin of certain heavy metals in these lake sediments with alternative anthropogenic sources such as the Ni and Cu smelting complexes located in Sudbury (Ontario) and Rouyn-Noranda (Quebec). The major sources of heavy-metal deposition and acid precipitation are thus associated with the long-range transport of emissions from fossil fuel combustion originating in the heavily industrialized American Midwest region.

F11564
OUELLET M, JONES HG, BERNIER G * **Contamination de la neige par les emissions atmospheriques de fluorures d'alumineries** * Sci Tech Eau * 16(4) 343-348 * Assoc quebecoise des tech de l'eau, Montreal, Que * 1983-11.

Apres avoir presente une breve revue de la documentation scientifique concernant la presence des fluorures dans l'environnement, les auteurs de cet article demontrent que les effets sur l'environnement de ces importants polluants atmospheriques et ce, principalement au Quebec, demeurent etonnamment inconnnus. La presente etude demontre qu'en mars 1978, en fonction des teneurs anormales de fluorures dans 344 echantillons de neiges, une contamination atmospherique originant de deux alumineries de la region du Saguenay-Lac Saint-Jean (Alma - ile Maligne; Jonquiere - Arvida) s'etend sur quelque 300 000 hectares des Basses-Terres de cette region du Quebec (Canada). Les teneurs en fluorures dans la neige, a proximite de ces alumineries, peuvent atteindre des concentrations jusqu'a 10 000 fois superieures aux teneurs naturelles.

063899
PAGEL JE * **A review of microbiological processes relevant to the effects of acidic precipitation** * 62p * Microbiol Sect, Lab Serv Branch, Ont Minist Environ * 1981-06.

The purpose of this report is to review some of the potential effects of acidic precipitation on the microbiota, and also to discuss contributions to this problem by microorganisms. Since all life in our biosphere is ultimately dependent on microbial activities, the dearth of supportive data on microbial processes related to acid rain is a serious shortcoming (13). Although not directly applicable, some information can be gleaned from studies on environments simulating the effects of acidic precipitation (e.g. acid mine waters, coal ash effluents and

in vitro experiments). Another indirect source of information is the literature on the major groups of microorganisms involved: that is, those responsible for the cycling of sulphur, nitrogen and carbon, primarily in aquatic and terrestrial ecosystems. For the purpose of clarity, as there is much overlap, this review will be organized into three main sections on the three cycles followed by a section on cycle interactions. The discussion of the reactions and the bacteria involved in the three cycles is not intended as an exhaustive review of the latest research in these areas, as this would not be within the scope of this report. It is intended only as a guide to focus on bacterial and chemical processes which may be involved in environments affected by acid rain.

065384
PATERSON WM * **Acid rain control cost/benefit assessment** , IN: A Specialty Conference on Atmospheric Deposition, November 7-10, 1982, Detroit, MI US * FREDERICK ER * 425-438 * Air Pollut Control Assoc, Pittsburgh, PA US * 1982.

Although studies indicate that Ontario Hydro sources contribute only a small amount to acid rain falling in sensitive areas in and around Ontario, the utility is being required to significantly reduce its total emissions over the next ten years. Various emission control options are being examined to determine their ability to meet these new emission limits. An appropriate emission control strategy must not only be cost-effective, but must also take into account the environmental implications of each option. A method is developed for assessing the relation between the costs of implementing acid-gas emission controls at Ontario Hydro's coal-burning generating stations and the benefits of reducing acid deposition in sensitive receptor areas. Using the results of recent Ontario Hydro studies the method initially derives a basic cost/benefit relation for various generating station-and-receptor area combinations. An inherent weakness in using this basic relation is that it rates all receptor areas as being of equal importance. The method is expanded to evaluate the relative importance of identified receptor area importance, including: size, rate of total acid deposition in the area, present acidification status based on lake alkalinity, and recreational value. Numerical importance values derived for each receptor area are then used to adjust the basic cost/benefit ratio. It is emphasized that these results are preliminary and only intended to illustrate the approach. The quality of data available for evaluating receptor area importance presently limits the applicability of the method. This type of analysis is offered as an apprcach for assessing the relationship between emission control costs and benefits to the environment when evaluating available control strategies.

F11619
PAULIN G * **Le Quebec et le phenomene des precipitations acides, une revue** * P.A.-6 * 40p * Minist de l'environ du Que, Dir gen des inventaires et de la recherche * 1982-11.

Le but de cet article est de decrire l'etendue des connaissances sur les effets des precipitations acides au Quebec. L'auteur decrit en premier lieu les causes et les mecanismes du phenomene d'acidification par le transport des polluants atmospheriques. Les autres volets couverts sur le sujet sont: les emissions et les transformations chimiques des polluants atmospheriques, les effets des depots acides au Quebec, le partage des responsabilites des depots acidifiants sulfureux, les effets hypothetiques du changement des normes d'emissions americaines, les etudes et activites en cours et les strategies de reduction des emissions de SO2 au Quebec.

064715
PEARSON FR * **Long-range transport implications for control of ambient air quality, Chapter 2** , IN: Waste Treatment and Utilization, Theory and Practice of Waste Management 2, Proc Second Int Symp Univ Waterloo, Waterloo, Ont, June 18-20, 1980 * MOO-YOUNG M, ROBINSON CW, FARQUHAR GJ * 11-20 * Pergamon Press, Toronto, Ont * 1982.

This paper discusses long-distance transport of pollutants and the implications of long-range transport on efforts to control pollution. After being emitted, pollutants may be transported over long distances to areas sensitive to their affects. This paper consists of an introduction to the problem and discusses control of pollution and government activities.

062620
PERLEY M * **Notes for speech by Michael Perley, Executive co-ordinator, Canadian Coalition on Acid Rain to the APCE/FACE/APAA Governmental Affairs Seminar** , IN: Environmental Government Affairs Seminar, Proc, Environmental Concerns of the 80's, October 12-15, 1982, Ottawa, Ont * 255-262 * Air Pollut Control Assoc and Fed Assoc Can Environ * 1982-10-14.

This paper discusses the experiences of the Canadian Coalition on Acid Rain in the United States and describes the progress that has been made towards a solution of the acid rain problem. The organization comprises 38 member organizations representing over one million Canadians. Its activities in Washington are registered under the Foreign Agents Registration Act and the Lobbying Act of the United States Congress. Recent debate on acid rain has focused on the differences between American and Canadian sources and receptors of acid rain. Some of these differences are

summarized. A summary is also given of problems concerning public awareness and education, which affect the resolution of the acid rain problem. Differences between the American and Canadian political system are noted and several legal issues are described. Controversial economic issues of particular concern to the Canadian Coalition on Acid Rain are discussed.

067049
PETERSON RH, HORD HHV (ED) * **1983 Workshop on acid rain** * Can Tech Rep Fish Aquat Sci 1213 * 84p * Dep Fish Oceans, Fish Environ Sci Div, Fish Res Branch, St Andrews, NB E0G 2X0 * 1983-09.

This report is a record of the papers presented at a Workshop organized by the Director of the St. Andrews Biological Station to review the results of research on acid rain carried out during 1982 under the aegis of the Fisheries and Environmental Sciences Division of the Fisheries Research Branch, Scotia-Fundy Region, Department of Fisheries and Oceans.

063872
PIERCE RC, WHELPDALE DM, SHEFFER MG (ED) * **Proceedings, Symposium on Monitoring and Assessment of Airborne Pollutants with Special Emphasis on Long-Range Transport and Deposition of Acidic Materials and Workshop on Air and Precipitation Monitoring Networks, Ottawa, Canada, 30 August - 3 September 1982** * NRCC 20642 * 502p * Natl Res Counc Can, Assoc Comm Sci Criteria Environ Qual, Ottawa, Ont K1A 0R6 * 1983.

These proceedings contain the invited Symposium papers along with the edited Panel Discussions immediately following the four main Symposium sessions on data needs, measurement techniques, siting criteria, operations, and quality assurance, and network design and data interpretation. The Symposium centred on the monitoring and assessment of airborne pollutants with emphasis on the long-range transport and deposition of acidic materials. Specifically, the Symposium provided a forum for the exchange of information on the methods of sampling and analysis of airborne pollutants, undertook a critical assessment of the methods of sampling and analysis of airborne pollutants including quality assurance and siting criteria, and provided the scientific basis for improving national networks on collection and analysis of air and precipitation quality data. The Workshop brought together those engaged in the direction and operation of networks and practical recommendations for monitoring network operations in Canada are presented on the standardization of measurement and collection techniques, quality assurance programs for Canadian networks, network coordination and central data banking, and data validity and comparability. Five papers on data needs, 3 papers on measurement techniques, 3 papers on siting criteria, operations and quality assurance, and 3 papers on network design and data interpretation, make up the main focus of the proceedings. A report by the chairman of each session is also included at the end of each session.

062975
POPE L * **Acid rain, a cloud on our horizon** * Western Fisheries * 102(5) 36-37,43 * 1981-08.

The threat of acid rain to British Columbia's salmon fisheries is examined to show that immediate planning is needed to prevent acid rain pollution of the province's rivers similar to Ontario's experience with lakes killed by acid rain, with the resulting fishkill. The sources and effects of acid rain, with particular reference to Ontario, are discussed. Concern about B.C. Hydro's proposed Hat Creek development scheduled to fire up in 1988, and the possible environmental effects of the resulting emissions, are expressed. Joint Canada - United States action on cleaning up emissions, is described.

065482
RAO SS, DUTKA BJ * **Influence of acid precipitation on bacterial populations in lakes** * Hydrobiologia * 98(2) 153-157 * 1983-01-23.

Relative abundance of total, respiring, aerobic heterotrophic, nitrogen cycle and sulfur cycle bacteria was measured in acid stressed and non-acid stressed hard water lakes. Data indicated that bacterial populations and densities were nearly an order of magnitude less in acid stressed waters than in non-acid stressed waters. Nitrifying bacteria and some sulfur cycle bacteria (Thiobacillus sp.) were very low or absent in acid stressed waters. Surface sediments of acid stressed lakes contained 3 to 4 times more organic matter than the amount found in the relatively more enriched lake. Methodology and data are presented.

064981
RO CU, CHAN WH, LUSIS MA, VET RJ * **Analysis of precipitation measurements in the vicinity of a nickel smelter** , IN: Proc 73rd Annu Meet Air Pollut Control Assoc, Montreal, Que, 22-27 June 1980 * v4 15p * (1980).

As part of the Sudbury Environmental Study, the Air Resources Branch of the Ontario Ministry of the Environment operates a daily precipitation sampling network in the Sudbury area. Its purpose is to provide data to evaluate the impact of INCO and Falconbridge smelter emissions, as well as long-range transport, on the local precipitation quality and wet deposition field. This paper focuses on the impact of the INCO operation. Precipitation is collected daily in

polyethylene bags, and analysed for pH and major ions, and trace metals. One of the major difficulties in evaluating various source contributions (local vs. long range transport) is the large magnitude of the background contribution. Unless a positive identification of the sector of plume-affected precipitation can be made, it is difficult to assess the local source impact. The data analysis was carried out by following a two-step process, meteorological stratification and sector analysis. The following information is tabulated: an evaluation of the background precipitation chemistry component associated with different types of air masses; relative contributions of the local sources and long-range transport to local precipitation quality; concentration dependence of the plume constituents in precipitation on distance from the source; wet deposition pattern of INCO emissions; and relative wet deposition in the Sudbury area due to local and distant sources.

064984
ROBITAILLE G * **Acid precipitation and vegetation** . IN: Proc 73rd Annu Meet Air Pollut Control Assoc, Montreal, Que, 22-27 June 1980 * v2 21p * (1980).

This paper is in two parts. The first part is an attempt to picture the sensitivity of the vegetation complexes found in eastern Canada by using an indirect method. The abundance of various vegetative species in 54 forest sections was estimated, and, taking into account relative sensitivities to sulfur dioxide, a weighted terrain sensitivity was determined. Part two describes a specific case of lichen sensitivity to pollutants, including acid precipitation, and demonstrates the difficulty that is encountered in describing cause-effect relationships in the field. Lichens are very sensitive to pollutants including acid precipitation. Discussion focuses on field observations made around a local source of sulfur dioxide, the emission of which had set up an acidity gradient in the area. Two sites were compared: a polluted site 6.5 km SE downwind from the source, and a control site. The disappearance of some epiphytic communities can be attributed to sulfur dioxide and its pH dependent toxic derivatives, metals and acid precipitation, impinging on the lichens.

062609
SANDHU HS * **Transboundary air pollution concerns of the 1980's: a provincial perspective from western Canada** . IN: Environmental Government Affairs Seminar, Proc, Environmental Concerns of the 80's, October 12-15, 1982, Ont * 236-247 * Air Pollut Control Assoc and Fed Assoc Can Environ * (1982).

The information presented in this paper is directed towards environmental managers and policy makers in the federal and provincial governments, in industry and in other institutions who are involved in transboundary air pollution issues. Interprovincial air pollution problems and possible approaches for their resolution are discussed from a provincial perspective for western Canada.

063855
SCHEIDER WA, DILLON PJ * **Predicting the chemical and physical effects of acidic deposition on aquatic and terrestrial ecosystems - information needs** . IN: Proceedings, Symposium on Monitoring and Assessment of Airborne Pollutants with Special Emphasis on Long-Range Transport and Deposition of Acidic Materials and Workshop on Air and Precipitation Monitoring Networks, Ottawa, Canada, 30 August - 3 September 1982 * PIERCE RC, WHELPDALE DM, SHEFFER MG * NRCC 20642 * 83-114 * Natl Res Counc Can, Assoc Comm Sci Criteria Environ Qual, Ottawa, Ont K1A OR6 * 1983.

The use of mass balance models is a promising approach to quantify the relationship between the deposition of strong acids (and their associated chemical constituents) and the physical-chemical changes in aquatic and terrestrial systems. Information on deposition is needed in the mass balance technique and these needs are addressed in this paper. The important constituents of deposition are strong acid (H+), strong acid precursors (SO2), and substances that undergo chemical or biological changes after deposition which result in the production of strong acid (NH4+) or base (NO3-). The total deposition of these constituents is needed, as separation into subcomponents (wet, dry) is of little value in predicting the physical-chemical effects on the environment. Deposition data on an annual basis are usually adequate for predicting long-term acidification. Daily deposition data are needed to predict episodic acidification. The spatial resolution needed in deposition measurements is also discussed.

065082
SCRUTON DA * **A survey of headwater lakes in insular Newfoundland, with special reference to acid precipitation** * Can Tech Rep Fish Aquat Sci 1195 * 115p * Dep Fish Oceans, Fish Res Branch, PO Box 5667, St John's, Nfld A1C 5X1 * 1983-08.

One hundred and nine (109) small headwater lakes on the island of Newfoundland, ranging in size from 21 to 2519 ha, were surveyed from August 16 to October 18, 1981. Lakes were sampled for morphometry, water chemistry, zoo- and nanno-plankton, sediments, benthos, and fish. Water chemistry was highly variable between lakes, with bedrock geology, input of marine aerosols and atmospheric deposition the dominant features controlling variability in chemical parameters. Lake pH varied from 4.90

to 8.39 with ten (10) lakes having a pH of less than 5.50. Ninety-three (93) lakes had alkalinities of less than 200 microns eq per L, indicating moderate to high sensitivity to acidification. Excess sulphate values ranged from 5.7 to 91.4 microns eq per L (mean of 34.5) and these levels are less than those reported for lakes experiencing moderate to high atmospheric loadings.

065245
SCRUTON DA * **The end of the funnel; Newfoundland and Labrador freshwaters in relation to acid precipitation** . IN: Proc of the thirty-sixth meeting of the Canadian Conf for Fisheries Research, held at Winnipeg, Jan 3 and 4, 1983 * p66 * Dep Fish Oceans, Resour Serv Dir * 1983-01.

A sample of 109 headwater lakes in insular Newfoundland were studied in 1981 to determine their chemical and biological status and sensitivity with respect to acid precipitation. These lakes, ranging in size from 21 to 252 hectares, were found to be highly sensitive to acid deposition and showed varying levels of response at present deposition rates. Over 85% of the study lakes were brown water lakes (colour greater than 15) indicating the presence of significant concentrations of organic acids which can both contribute to acidification and moderate the influences of toxic metals. Brook trout (Salvelinus fontinalis) and ouananiche or landlocked salmon (Salmo salar) were the most abundant fish species in the study lakes while brown trout (Salmo trutta) and anadromous Atlantic salmon (Salmo Salar) were also caught. Tissue samples from 1200 fish were analyzed for eight trace metals. Mercury levels in fish tissue ranged from 0 to 50 ppb while aluminum levels ranged from 0 to 220 ppb. There is no clear evidence of the absence of any species in relation to acidification in any of the study lakes. Water quality was monitored on 22 Atlantic salmon rivers in insular Newfoundland on a monthly basis from May 1981 to May 1982. Several rivers demonstrated extreme sensitivity to acid deposition as evidenced by the large fluctuation in pH and other water quality parameters on an annual basis. Depressions of pH in association with high runoff were evident in most rivers with maximum depressions occurring in the spring months (April and May) in some rivers and in the late fall (November and December) in other rivers. In many of these rivers minimum pH values were less than 5.0, reaching levels that are potentially threatening to aquatic biota.

063854
SHAW RW * **The modeller's needs with respect to the monitoring of the long-range transport of acidic materials** . IN: Proceedings, Symposium on Monitoring and Assessment of Airborne Pollutants with Special Emphasis on Long-Range Transport and Deposition of Acidic Materials and Workshop on Air and Precipitation Monitoring Networks, Ottawa, Canada, 30 August - 3 September 1982 * PIERCE RC, WHELPDALE DM, SHEFFER MG * NRCC 20642 * 57-82 * Natl Res Counc Can, Assoc Comm Sci Criteria Environ Qual, Ottawa, Ont K1A OR6 * 1983.

A brief description is given of some of the techniques used in the modelling of the long-range atmospheric transport and deposition of acidic materials, as well as of some of the aspects of the atmospheric processes where our knowledge is weak (e.g. chemical transformation and deposition). Some programs of routine and specialized monitoring are proposed that will help test the models' predictions and improve the models through better knowledge of the parameterization constants and the atmospheric processes themselves. This would also shed some light on such issues as the linearity of the chemistry, the relative importance of dry deposition, and the importance of medium-range vs. long-range transport.

065227
SHEWCHUK SR * **A precipitation study be event collection from Reindeer Lake, Saskatchewan** * SRC Tech Rep No 135 * 23p * Sask Res Counc, Saskatoon, Sask * 1982-09.

Event collection of precipitation was carried out during the summer of 1981 near Southend, Saskatchewan on Reindeer Lake. The rain was chemically analyzed for major ions of sulphate and nitrate. In addition, sample pH values were determined. While sulphate and nitrate concentrations in the rain were generally quite variable, most of the sulphate was in the concentration range 0.30 to 0.72 mg/L and most of the nitrate was in the range 0.12 to 0.40 mg/L. One day back-trajectories were drawn for the periods corresponding to the ending of precipitation. In general it is seen that northerly air trajectories corresponded to more dilute rain samples than southerly air trajectories. The influence of naturally occurring forest fires is shown to significantly influence background rain chemistry. All rain samples collected can be termed acidic as based on electrode pH determinations, with a range of values of 4.82 to 3.90. However, the low solution ionic conductivities and other well-known difficulties in measuring pH of natural systems bring these values into question. Due to the highly sensitive character of the natural ecosystems significant increases in research activities for the area are recommended.

065216
SHEWCHUK SR * **Regional transport of air pollutants and associated ecosystem sensitivities within a selected area of western Canada** * 33p * Sask Res Counc, Saskatoon, Sask * 1981-06.

The deposition of sulphur and nitrogen compounds within the study area of western Canada is low at the present time, but is expected to increase within the next two decades, mainly because of emissions. Due to a lack of alkaline material, precipitation in a large section of the study area is not well buffered against an anion input. There is a narrow limestone zone running approximately diagonally through the project region. Systems lying to the north of this zone exist on the Precambrian Shield and are highly sensitive to acidic depositon. Systems lying to the south are influenced by a very complex network of buffering agents and are relatively insensitive to the effects of acidic deposition. One-half of the project region consists of freshwater lake systems that have water chemistry parameters which describe these lakes as being highly sensitive to acidic deposition. Present day levels of acidity measurements taken from the sensitive lakes in the project region indicate that the lakes support healthy fish populations. The potential irreversibilities dictate that systems which are on the verge of acidification be subjected to immediate research to ascertain the properties of the mechanisms of direct acidification.

065554
SIMMONS R * **Acid rain - environmental crisis of the eighties** . IN: Acid rain/fisheries, Proc Int Symp on Acidic Precipitation and Fishery Impacts in Northeastern North America, Ithaca, NY, 2-5 Aug 1981 * HAINES TA (chairman) * 7-11 * Am Fish Soc, Northeast Div, 5410 Grosvenor Lane, Bethesda, MD 20814 US * 1982.

Two facts make acid rain a top priority issue. First, in Canada, one million square miles are particularly sensitive to acid deposition and are seriously overloaded now. Second, a significant portion of our economic activities and a wide range of societal interests are threatened by acid rain. Effects of acidic precipitation have been perceived in Ontario, Nova Scotia and Quebec. Stress is also showing in the United States (Adirondacks, New England and parts of the mid-west) and in the forests of Europe (Sweden, Germany, France, Switzerland, Yugoslavia, Czechoslovakia and Poland). In addition to damage to the ecosystems, there is concern for damage to human health, by the inhalation of fine particulates, mainly sulfates, and by the increase of heavy metals in water supplies and food. Acid rain has economic effects on our aquatic tourism industry, and on fisheries and forestry. It also affects cultural, esthetic and long term ecological values. In 1978, a Canada - United States Bilateral Research Consultative Group was established to coordinate research and improve our understanding of long range air pollutant transport. A Memorandum of Intent was signed by the two countries in 1980 to negotiate a bilateral air quality agreement. Some powerful American forces argue that not enough is known about acid rain to justify control measures now. The loud public outcry in Canada will have to be matched by a similar outcry in United States.

065566
SMITH L * **Information needs for regulatory control of acidic precipitation** . IN: Acid rain/fisheries, Proc Int Symp on Acidic Precipitation and Fishery Impacts in Northeastern North America, Ithaca, NY, 2-5 Aug 1981 * HAINES TA (chairman) * 257-264 * Am Fish Soc, Northeast Div, 5410 Grosvenor Lane, Bethesda, MD 20814 US * 1982.

The major information needs for a regulatory control program for acid rain include: the sources of emissions; transport processes; sensitive geographical areas; dose-response relationships of organisms and ecosystems; and finally, an integrated analysis. We are concerned mainly with sulfur and nitrogen oxides. We would like to know what economic sectors are releasing emissions, and future projections by sector and geographic region. There is a pattern of high density in the Ohio River Basin, as well as in Sudbury. The electric utility industry is responsible for two thirds of the national SO2 emissions. Other industrial combustion and ore smelting accounts for most of the remainder. Atmospheric transport is complex, and a good model has yet to be developed. Sensitive geographic areas have not yet been well delineated. Integrated analysis is tentative as yet. Liming is not a viable long-term alternative to neutralizing at the source, for thermodynamic reasons. We must use sulfate deposition as our surrogate for hydrogen ion deposition, and the atmospheric correlation between hydrogen ion and sulfate is not very good. To reduce emissions, low-sulfur coal can be burned; the coal can be physicall washed to remove pyritic sulfur; or plants can be retrofitted for flue-gas desulfurization. These techniques are not cheap. There will be little movement toward emission control until the body politic debates the tradeoff of long-range protection of its natural heritage versus the short-term cost of such protection. We must decide while not knowing the results of our actions, until, through delay, we may have destroyed what we are trying to protect.

065564
SPENCER HT * **Acid rain chemodynamics** . IN: Acid rain/fisheries, Proc Int Symp on Acidic Precipitation and Fishery Impacts in Northeastern North America, Ithaca, NY, 2-5 Aug 1981 * HAINES TA (chairman) * 33-41 * Am Fish Soc, Northeast Div, 5410 Grosvenor Lane, Bethesda, MD 20814 US * 1982.

The underlying features of acid rain precursor synthesis, transport and deposition

are reviewed with respect to recent (1940-1980) history, and with regard to prospects for the future. Maintenance of the Clean Air Act as an instrument of regulation of acid rain precursors is seen as necessary, as is the need for keeping in force through the Act, those standards designed to protect the nation's ecosystem. Evidence is cited in published reports of the United States Environmental Protection Agency to indicate that this can be done without undue economic burden.

066688
STRACHAN WMJ, HUNEAULT H * **Evaluation of an organic automated rain sampler** (see chapter 3.1 for complete reference - voir chapitre 3.1 pour la reference complete)

065381
SUMMERS PW * **From emission to deposition: processes and budgets**, IN: A Specialty Conference on Atmospheric Deposition, November 7-10, 1982, Detroit, MI US * FREDERICK ER * 15-45 * Air Pollut Control Assoc, Pittsburgh, PA US * 1982.

Recent estimates of the sources and emission rates for the most important substances contributing to the acidity of deposition are reviewed and summarized. Both natural and anthropogenic emissions are considered with emphasis on their differing physical and chemical characteristics and geographical distributions. For sulfur species, man-made emissions account for approximately 40% of the global total, but are concentrated in a few heavily industrialized regions mainly in the northern hemisphere, and represent a net input to the air/surface interface zone. In contrast, natural emissions are more evenly spread over the globe and mainly constitute a recycling of sulfur through the air/surface zone. Nitrogen emissions are less well documented but again localized man-made emissions are outweighed by the more widespread natural sources. The main contributing regions to neutralizing alkaline species in the atmosphere are the intensely farmed dry continental interiors and deserts. The role of vertical mixing, synoptic scale transport, chemical interactions and residence times in determining the global distribution of various species in the atmosphere and the resultant wet and dry deposition patterns are discussed. Monitoring data from global and regional deposition networks show a strong geographical association between deposition patterns and emissions distributions for various species. Maximum acidic deposition occurs over and immediately downwind of man-made source regions; identification of the sources of acidic deposition in more remote areas is less certain. The above analyses are integrated through a discussion of global and regional budgets. These budgets clearly show the relative importance of various input and output terms which in turn place the local and regional acidic deposition issues in the global context. Finally, some outstanding issues and problem areas are highlighted together with an indication of the monitoring and research required to further improve knowledge of the extent and nature of acidic deposition.

F10851
SUMMERS PW * **Sources, transport atmospherique et depot acide: une perspective mondiale** * Bull qual eaux * 8(2) 81-88 * Cent collab pour la qual eaux, Cent can eaux inter, Burlington, Ont * 1983-06.

Les precipitations atmospheriques ont toujours contenu diverses combinaisons de substances chimiques de sources naturelles. C'est dans les regions industrielles et immediatement en aval de celles-ci que les effets des metaux en traces, des matieres organiques et surtout de pluies acides se font sentir. Sur l'ensemble du globe terrestre, les emissions naturelles depassent les emissions d'origine anthropique d'environ 40%, mais cet ecart varie en fonction du developpement industriel et de l'efficacite avec laquelle les emissions de SO2 sont controlees, et la situation est bien differente dans les deux hemispheres. Les emissions naturelles des deux hemispheres sont largement reparties a de faibles taux et les oceans en sont la principale source. Dans l'evaluation de la chimie atmospherique a l'echelle mondiale, un concept important est celui du temps de sejour des differentes substances. On presente au tableau 5, un resume des taux du pH des precipitations observees dans les regions eloignees du globe.

067124
SUMMERS PW * **A global perspective on acid deposition, its sources and atmospheric transport** * Water Qual Bull * 8(2) 81-88,109 * WHO Collan Cent Surface Ground Water Qual, Can Cent Inland Waters, Burlington, Ont * 1983-04.

The chemical constituents of atmospheric precipitation which are directly related to the presence of these constituents in the air, are discussed. The sources of acidic and alkaline species in the atmosphere, including sulphur, nitrogen and alkaline emissions, are outlined, as well as their release into the atmosphere, redistribution locally, regionally and globally and the resulting concentrations of the various species in the atmosphere which determine the deposition patterns over the same spatial scales. Initial mixing, advective transport and dispersion, and chemical transformations, are included. The removal of the pollutants from the atmosphere by dry and wet deposition and the implications of these processes in the long-range transport of pollutants, are examined. Empirical approaches to incorporate these processes in

atmospheric models are discussed, including dry disposition ratio and scavenging ratios or rates. Also described are atmospheric modelling, characterictics of Nothern Hemisphere precipitation, background pH, and residence times for pollutants in the atmosphere.

064760
TOLBA MK * **Acid rain - a growing concern of industrialized countries** * Water Qual Bull * 8(3) 115-120,167-16 * WHO Collaborating Cent on Surface and Ground Water Qual, Can Cent Inland Waters, Burlington, Ont * 1983-07.

Acidification is an environmental problem, or becoming one, in parts of Europe and North America. Around five to ten million square kilometers of these continents are affected. Similarly polluted areas are likely to exist elsewhere in the world, especially around large urban and industrial conglomerations. Industrial regions of the world suffer much more acidic fallout than they did before the industrial revolution. This is because power plants, some industrial processes, vehicles and homes emit sulphur and nitrogen compounds, mainly from the burning of fossil fuels, and have greatly increased the concentrations of these compounds in the environment. Natural processes also emit sulphur and nitrogen compounds into the air in addition to man-made sources. Each country gets part of its acid fallout from its own pollutants, but receives the rest on the winds from neighbouring countries. Problem areas include aquatic regimes, the terrestrial regime, human health and materials corrosion. Representatives of 21 countries agreed that urgent action should be taken under the Convention on Long-range Transbourndary Air Pollution.

063269
TORRENUEVA AL * **Effects of acid-rain on terrestrial ecosystems** * Ont Hydro Res Rev * (2) 49-55 * Ont Hydro, 800 Kipling Ave, Toronto, Ont M8Z 5S4 * 1981-05.

The current state of knowledge on the effects of acid precipitation on vegetation and soils is assessed. Research studies, mostly from North America and Scandinavia, dealing with the effects of simulated acid rain on vegetation, soil chemistry, soil biology and soil biochemical processes are reviewed with particular emphasis on northern temperate forest ecosystems. The studies reviewed to date have not revealed any effects of acid precipitation on vegetation and soils under natural field conditions. The coniferous forests of Ontario do not seem to be in immediate danger from acid precipitation because of ample nutrient reserve in the soil and the relatively well-buffered acid forest soil. However, more biogeochemical studies are needed in other forest ecosystems such as hardwoods.

063271
TORRIE R * **Acid rain: the implications for energy policy** * Alternatives * 11(2) 40-48 * Alternatives, c/o Trent Univ, Peterborough, Ont K7J 7B8 * 1983.

The author states that the choice of producing electricity by coal-fired plants which emit sulphur and nitrogen oxides, or with nuclear complexes, is a false choice. The relevant comparison must be between new nuclear plants and cleaned up oil plants. Scrubbers could be installed in Ontario Hydro's coal plants for a fraction of the cost of new nuclear capacity. Since nuclear plants require coal plant backup, it is possible that Ontario Hydro will produce more acid rain with a nuclear dominated system using dirty coal for backup capacity than with a system where more nuclear capacity is rejected. Under the auspices of Friends of the Earth Canada, a major 2-year effort to produce a soft energy path study for Canada has been completed. Soft paths are based on the principle of matching quantity and quality of energy source to end-use requirements with a diverse combination of technologies which run on renewable energy flows. The soft path offers a more benign energy system than its hard-path counterpart. The study concludes it would be technically feasible and cost-effective to operate the Canadian economy in 2025 with 12% less energy than in 1978, and to shift from 16% to 77% reliance on renewable resources. Biomass emerges as the dominant source of low entropy fuel.

065558
TUOMI ALW * **Socio-economic measurement of acid rain impacts on fisheries** . IN: Acid rain/fisheries, Proc Int Symp on Acidic Precipitation and Fishery Impacts in Northeastern North America, Ithaca, NY, 2-5 Aug 1981 * HAINES TA (chairman) * 309-315 * Am Fish Soc, Northeast Div, 5410 Grosvenor Lane, Bethesda, MD 20814 US * 1982.

An approach to the socio-economic measurement of the impacts of acid rain on fisheries is outlined. Acid rain inflicts losses and decisions have to be made despite uncertainty respecting bio-physical impacts and their economic consequences. Fisheries losses are approached in an economic, market-related context because other admittedly important aspects of loss pose inherent problems of quantification; notably, the fisheries' ecological role, social and distributional aspects and certain "extra-market" values. The brunt of loss is incurred by vulnerable freshwater fisheries. This requires valuing fisheries and differentiating between the value of the fishery as an asset and its annual output. Value flows from willingness to pay regardless of use. The fisheries' asset and annual output can be valued where fisheries operate within the market. Common-property fisheries require simulating these values. It is held that the

angler "produces" and consumes sportfishing and the expenditures made correspond in national income and expenditure terms to the marketed value of commercial fisheries output. Measuring acid rain impacts devolves into quantifying potential asset and output losses. Numerous other problems remain with respect to selecting and actually developing the kinds of economic values required, including fisheries insurance values.

065330
UNDERWOOD JK • **Monitoring acid precipitation** • vp • NS Dep Environ, Halifax, NS • 1982-02-01.

A brief review is presented of techniques for measuring wet and dry atmospheric deposition. The paper discusses the whats, nows and wheres of sample collection, sample handling in the field, sample preservation, and sample analysis. Although much of the paper is drawn from published sources, some results are included of studies by the Nova Scotia Department of the Environment. In particular, preliminary results of chemical change with storage of up to one year are shown, and some guidelines for the average chemistries of lakes and precipitation are suggested.

065325
UNDERWOOD JK • **PH of precipitation and annual deposition of acidity, nitrogen and excess sulfate on Nova Scotia** • 23p • NS Dep Environ, PO Box 2107, Halifax, NS B3J 3B7 • 1980-07-15.

Results of a one and-a-half year study of precipitation chemistry in Nova Scotia are presented. Volumetrically adjusted mean pH between 1977 and 1979 was 4.71, and 85% of all samples were less than 5.7 Loadings of excess (non-marine) sulfate, hydrogen ion, total acidity, nitrate nitrogen and ammonia nitrogen were 43.3, 26.3, 92.7, 15.8 and 14.2 meq per sq m per year respectively. Such loadings are generally less than those in areas of Europe and northeastern North America, but comparisons with scanty data from 1950 do show doubling of deposition of nitrate, and a 14-fold increase in hydrogen ion. Ammonia and excess sulfate deposition showed little change in 25 years.

066757
UNDERWOOD JK • **Environmental impacts of coal utilization** • 60p • NS Dep Environ, Box 2107 Halifax, NS B3J 3B7 • 1981-08-10.

This report reviews environmental impacts on coal utilization. The impacts were considered to fall into four categories and are discussed as such. First, a review of trace contaminants in coal and fly ash examines the properties and consequences of: 1) metals; 2) organic compounds particularly benzo-a-pyrene, dioxin and tetrachlorodibenzo-p-dioxin, and; 3) radioactive contaminants. Second, waste products from coal combustion and the disposal of these wastes are discussed. By way of solution, pulverized fuel ash is presently being used as a filler for cement and it is proposed that it could be used as a fertilizer and as a neutralizing agent for landfill sites and acidified lakes. Third, the phenomenon called "the green house effect" is explained and how CO2 is important in maintaining climatic stability. Finally, the emission and dispersion of atmospheric pollutants is considered. The discussion centers on oxides of sulphur and nitrogen and the resulting acid precipitation.

066736
UNDERWOOD JK • **Acidic precipitation in Nova Scotia** • 24p • NS Dep Environ, Box 2107 Halifax, NS B3J 3B7 • 1981-04-01.

This report examines the concerns about acid precipitation in the province of Nova Scotia. Fossil fuel combustion for generating electricity resulted in 47% of all SO2 emissions in the Province in 1980 and future emissions will rise as a result of a proposed installation at Lingan. The highest deposition of sulphur and nitrate occur around Bridgetown on the Bay of Fundy coast. Estimates of the amount of deposition from the Province's own sources are presented. The effects of acid precipitation on select lakes are discussed. The proportion of alkaline-loving species in these lakes have fallen while the proportion of acid-loving species has rised. Results of programs of liming lakes and rivers in the province are discussed.

066716
UNDERWOOD JK, HINCH PR, VAUGHAN HH • **Acid rain and lakes in Nova Scotia, draft report. I. Annotated bibliography of studies of Nova Scotia lakes** • 84p • NS Dep Environ, PO Box 2107, Halifax, NS B3J 3B7 • 1982-11.

This report outlines, in short form, the plans for a study on acid rain in Nova Scotia lakes. This initial report presents the first version of Part I, which is an annotated bibliography of acid rain studies conducted in the province from 1906 to 1982 inclusively. This bibliography includes published literature, government documents, university research and consultants' reports. In preparing this bibliography, it was hoped that the following elements would be included: a complete reference, number of lakes studied in the report, purpose of each study, study dates, parameters and methods of analysis used, principal researchers, summaries of results and short descriptions as to the study's relevance to lake acidification.

066983
VAN VOLKENBURGH G • **Federal and provincial LRTAP programs in Canada** . IN: Acid

deposition, knowns and unknowns: the Canadian perspective, Proc, Montreal, Que, 7-8 Apr 1981 * 14p * APCA (Air Pollut Control Assoc) (Ontario/Quebec) and Fed/Prov LRTAP Sci Comm * (1981).

The speaker describes plans for the 2-day meeting, and lists written materials on LRTAP work in Canada which are provided to those present. He discusses briefly programs by each provincial government and by the federal government. He focuses on program coordination in Canada: between federal and provincial governments; in regions, for example, Central and Western Canada; and as well, international coordination between Canada and United States. In conclusion, he asks for opinions from the audience on program needs and recommendations.

063860
VET RJ * **A review of current wet deposition measurement techniques** , IN: * Proceedings, Symposium on Monitoring and Assessment of Airborne Pollutants with Special Emphasis on Long-Range Transport and Deposition of Acidic Material and Workshop on Air and Precipitation Monitoring Networks, Ottawa, Canada, 30 August - 3 September 1982 * PIERCE RC, WHELPDALE DM, SHEFFER MG * NRCC 20642 * 219-243 * Natl Res Counc Can, Assoc Comm Sci Criteria Environ Qual, Ottawa, Ont K1A OR6 * 1983.

A review is given of wet deposition measurement techniques, with emphasis on sampling periods, instrumentation, sample collection and handling procedures, and laboratory analysis. It was shown that these techniques are highly interdependent and are also strongly affected by several outside factors, such as network objectives, siting criteria, and organizational constraints. In addition to reviewing the actual techniques currently used, a discussion is given of their suitability with respect to the ideal, and recommendations for improvements are made.

063552
VICTOR & BURREL, AND JE HANNA ASSOC, HOUGH, STANSBURY & MICHALSKI LTD * **Methods for assessing the socio-economic impact of acid rain on Canada's fisheries** * 140p * 1981-09.

This report presents a framework for assessing the socio-economic consequences of adverse effects of acid rain on Canada's fisheries. It identifies the links between acid deposition, its effect on fishing yields, the economic value of these effects and their social consequences. The extent of the acid rain problem in relation to fisheries is indicated by several maps which show the actual and potential distribution of impacts across Canada. The main focus of the report is on methods for the socio-economic assessment of the present and possible future damages. It is concluded that the most promising approaches for valuing losses to sport fishing are a modified travel cost method (based on D.R. Talhelm's work), and contingent valuation. The latter method can also be applied to commercial and subsistence fishing, and can encompass user and non-user fishing values. Travel cost studies, which utilize data on actual behaviour, have the advantage of not relying on people's responses to questions about valuation. Such questions are usually hypothetical and the responses may be biased. However, the contingent valuation method can be more comprehensive in its coverage and more flexible in its use than the travel cost approach. Income and employment impacts of acid rain can be addressed at the provincial level through input-output analysis. Assessment of sub-provincial impacts, both economic and social require area specific studies. The success of such studies will likely depend on the extent of community cooperation and involvement. The report concludes with some specific recommendations for further study and a review of information sources.

062924
WALMSLEY JL, MAILHOT J * **On the numerical accuracy of trajectory models for long-range transport of atmospheric pollutants** * Atmos-Ocean * 21(1) 14-39 * 1983-03.

A method of evaluating the accuracy of trajectory models for the Long-Range Transport of Atmospheric Pollutants (LRTAP) is described. The method involves derivation of horizontally non-divergent wind fields from stream functions that are dependent on latitude and longitude. Appropriate choice of seven adjustable parameters enables a fairly realistic simulation of frictionless flow to be made. The differential equations for trajectories in these analytically specified flows are solved numerically with a high degree of accuracy, giving a standard against which results from trajectory models may be compared. Theoretical estimates suggest that an important source of error in LRTAP trajectory models is horizontal interpolation of wind data. This error is significantly reduced through use of a cubic interpolation scheme. Theory also indicates that truncation error in the trajectory equation can be made almost negligible in comparison with observational errors by using a "constant-acceleration" scheme. A linear scheme for temporal interpolation of wind data is shown to be sufficiently accurate, if observational and horizontal interpolation errors are considered. Likewise, an assumption of constant-map scale factor during each time step is shown to give errors that are negligible except in cases of strong meridional circulation. An example of an application of the method to a trajectory model is used to confirm the theoretical conclusions regarding horizontal interpolation of wind data.

062995
WELLER P * **Industry and acid rain: the Canadian corporate response** * Alternatives * 11(2) 21-24 * Alternatives, c/o Trent Univ, Peterborough, Ont K7J 8B8 * 1983.

This article analyses the pattern of response to the issue of acid rain by major Canadian corporate sources of acid-causing pollutants. Four examples are discussed: Inco, Noranda Mines Limited, Ontario Hydro, and Cominco Limited. By examining the actions and responses of these companies much light can be shed on the problem of acid rain, and the roadblocks to controlling it that currently exist. The cases examined indicate that major corporate sources of acid rain in Canada have generally avoided coming to grips with the problems created by their pollutant emissions. Only at Cominco have emissions been reduced to the lowest level possible; the imposition of a government control order prompted by public pressure and international concern has prevented the sulphur damage that could have resulted from the smelter. The reasons for the success at Cominco are instructive for the future of the acid rain issue everywhere.

063853
WHELPDALE DM * **Monitoring and assessment in Canada** , IN: Proceedings, Symposium on Monitoring and Assessment of Airborne Pollutants with Special Emphasis on Long-Range Transport and Deposition of Acidic Materials and Workshop on Air and Precipitation Monitoring Networks, Ottawa, Canada, 30 August - 3 September 1982 * PIERCE RC, WHELPDALE DM, SHEFFER MG * NRCC 20642 * 25-52 * Natl Res Counc Can, Assoc Comm Sci Criteria Environ Qual, Ottawa, Ont K1A OR6 * 1983.

This paper is intended to provide a context for the Symposium on Monitoring and Assessment of Airborne Pollutants, in terms of current atmospheric science knowledge and worldwide monitoring network operation. Four facets of atmospheric science are reviewed briefly: biogeochemical cycles, time and space scales, substances of interest, and transformation and removal pathways. The status of Canadian monitoring is compared with that in other countries and parts of the world. It is concluded that the tremendous progress made during the past 5 to 10 years has resulted in state-of-the-art monitoring in this country. Nevertheless, to meet anticipated future demands, it is suggested that effort now must be directed to areas of coordination, quality control and assurance, data assessment, and user needs.

F10850
WHELPDALE DM * **Depots acides: repartition et incidences** (see chapter 4.16.4 for complete reference - voir chapitre 4.16.4 pour la reference complete)

067123
WHELPDALE DM * **Acid deposition: distribution and impact** * Water Qual Bull * 8(2) 72-80,109 * WHO Collab Cent Surface Ground Water Qual, Can Cent Inland Waters, Burlington, Ont * 1983-04.

This article focuses on the characteristics, distribution, and impact of acid deposition and includes a discussion of "acid related" substances and deposition mechanisms, an examination of the magnitude and spatial features of acid deposition, and an investigation of some of the more serious effects. The increase in effort that has been devoted to precipitation chemistry monitoring during the past decade including the WMO Background Air Pollution Monitoring Network, the European Air Chemistry Network, the Canadian Network for Sampling Precipitation, and the U.S. National Atmospheric Deposition Program is discussed. Measurement of wet and dry deposition in Europe and North America, are described. Effects of acid deposition on structures, foods, drinking water, soils, vegetation, wildlife, and aquatic ecosystems, are detailed. Changes in the perception of the problem of acid deposition that have taken place over the past 10-15 years in Europe and North America with greater awareness and efforts to control the problem, are discussed. Also, some of the difficulties and challenges that still remain, are noted.

066192
WORK GROUP 3B, EMISSIONS, COSTS AND ENGINEERING ASSESSMENT * **United States - Canada, Memorandum of intent on transboundary air pollution, emission, costs and engineering assessment, Final report** * vp * 1982-06.

This is a final report prepared by the United States/Canada Work Group on Emissions, Costs and Engineering Assessment in accordance with the Memorandum of Intent on transboundary air pollution. The first chapter of the report summarizes the major findings and conclusions in terms of the major analytical elements: emissions, technology for control, and costs. Chapter B analyzes the emission trends for SO2 and NOx in the United States and Canada. Chapter C presents data and information on emission control technologies and associated costs for all major source categories. Chapter D presents preliminary data on other pollutants (SO4, volatile organic compounds and heavy metals). A discussion of the constraints on and boundary analysis of emission projections is presented in Chapter E. The final chapter of the report outlines the present and planned research activities of the two countries and suggests some future research development needs. Presented in the appendices to the report is more detailed information on the methodologies used to calculate the emission inventories and future emission projections, and the emission inventory for 1978 used for Work Group 2 in its modelling work. Control technologies for

SO2 abatement and current research and development projects are also described.

065382
YOUNG JWS * **From emission to deposition: modelling and source - receptor relationships** , IN: A Specialty Conference on Atmospheric Deposition, November 7-10, 1982, Detroit, MI US * FREDERICK ER * 46-81 * Air Pollut Control Assoc, Pittsburgh, PA US * 1982.

Atmospheric models can be broadly classified as either Eulerian or Lagrangian. Within these two categories a multitude of model formations exist in the field of long range transport (LRT). This paper reviews recent work in atmospheric LRT modelling, paying particular attention to the parameterizations used, the sources of error, the accuracy of the input data and the time and space scales of interest. The short-term and long-term performance of various LRT models is examined for both the European and North American applications. The use of LRT models to generate source-receptor relationships emphasizes the forecasting of deposition of sulfur compounds in Eastern North America. Recent modelling experiments in atmospheric chemistry and transport have also been reviewed to determine their impact on source-receptor links. The paper summarizes the major outstanding issues.

066991
YOUNG JWS * **Long range transport models: how they work and their results** , IN: Acid deposition, knowns and unknowns: the Canadian perspective, Proc, Montreal, Que, 7-8 Apr 1981 * 25p * APCA (Air Pollut Control Assoc) (Ontario/Quebec) and Fed/Prov LRTAP Sci Comm * (1981).

The 1980 Memorandum of Intent (MOI) on Transboundary Air Pollution, signed by Canada and United States, sets up a workshop structure and timetable to support negotiations leading to a treaty between the 2 countries. This paper gives an overview of the modelling work by the Atmospheric Sciences and Analysis Working Group II. Its purpose is to describe the state-of-the-art source-receptor relationships based on available model results and measured deposition values from monitoring networks. It is believed that the working group has produced the best available information to date to guide the development of transboundary air pollution control strategies in both countries. Sub-models for the transport of pollutants, for chemical transformations of the pollutants, and for wet and dry removal of pollutants as they are transported, are the basic components of a long range transport model. The main inputs are an emission inventory of pollutants, meteorological and ground cover data, and parameter values. Five models are evaluated and compared: AES-LRT Model of the Atmospheric Environment Service of Canada; OME-LRT Model of the Ontario Ministry of the Environment; ENAMAP-1 Model developed by SRI International; ASTRAP Model of the Argonne National Laboratory; and RCDM-2 Model (Regional Climatological Dispersion Model) of the University of Illinois. All five are successful in describing ambient sulfate and/or wet sulfur deposition on an annual basis. Hydrogen and nitrate ion deposition have not yet been successfully evaluated in LRT models.

4. SURFACE WATER - EAUX DE SURFACE

4.1 Streamflow, Levels and Flows - Debit, niveaux et regimes

065008
ALBERTA ENVIRON, HYDROL BRANCH, TECH SERV * **South Saskatchewan River Basin, Historical natural flows, 1912 to 1978** * 119p * Alta Environ, Hydrol Branch, Tech Serv Div * 1982-11.

This report presents the methods and results of a study to determine monthly mean natural flows of rivers at selected locations in the South Saskatchewan River basin in Alberta. Natural flows were developed at 57 hydrometric station locations and 43 points of interest. The flows are monthly mean values for the period 1912 to 1978. The report is composed of sections which outline the selection of natural flow points, the identification of man-made projects, the natural flow calculation method, the data requirements, typical natural flow calculations, and a discussion of the results. Detailed results and methods are presented in six appendices in separate volumes which cover the streamflow files, precipitation, evaporation, reservoir storage, irrigation, and streamflow travel time.

064850
ALTA DEP ENVIRON, TECH SERV DIV, HYDROL BRANCH * **Natural flow, Battle River at Alberta - Saskatchewan boundary** * 111p * Prairie Prov Water Board * 1982-06.

This report on the natural flow of the Battle River at the Alberta/Saskatchewan boundary describes the basin geography, the analytical approach of the study, water use within the basin, the derivation of historical natural flows, and analysis of the present (1979) level of use in conjunction with natural flows to indicate the potential for apportionment deficits. The study concludes that: the 13,900 acre - feet of water presently (1979) used in the Battle River basin to the Alberta/Saskatchewan boundary in an average year represent 6.1% of the average annual natural flow of the river at that

boundary; during 1912 - 1979, no less than 50% of natural flow would have passed to Saskatchewan; that the average annual quantity delivered to Saskatchewan in excess of 50% of natural flow during that period was 101,000 acre - feet; and, the minimum surplus during any one year was 3,900 acre - feet in 1941.

062897
BADDOUR RE, ABBINK H * **Turbulent underflow in a short channel of limited depth** * J Hydraul Eng * 109(5) 722-740 * ISSN 0733-9429 * 1983-05.

The flow characteristics of a turbulent underflow in a horizontal channel of limited depth are explored analytically and experimentally under a variety of upstream and downstream control conditions. Freshwater and salt water are used in the physical model to simulate a stable density stratification, and a contraction is adopted as a downstream control device. Three typical flow situations, respectively, distinguished as drowned internal jump, free internal jump, and flow instability, are observed depending on the nature of the interaction between the upstream and downstream controls. The hydraulic properties of each one of the flow situations are reviewed, and the experimental observations are compared with the results obtained from a hydraulic analysis. Maximum turbulent mixing is demonstrated to occur at a particlular value of the discharge densimetric Froude number. Further increase of discharge densimetric Froude number is expected to result in a decrease in turbulent mixing and eventually to provoke a flow instability.

066973
BRAGA BPF, LINSLEY RK, FRANZINI JB * **The value of real-time streamflow forecasting for multi-objective reservoir operation** (see chapter 4.5 for complete reference - voir chapitre 4.5 pour la reference complete)

062245
BRINKMANN WAR * **Association between net basin supplies to Lake Superior and supplies to the lower Great Lakes** * J Great Lakes Res * 9(1) 32-39 * 1983.

Eigenvector analysis was carried out on monthly net basin supplies for the Great Lakes for the period 1900-1973. The results show that the supplies to Lake Superior are to a large degree uncorrelated with those to the lower lakes. However, very large supply anomalies tend to be of the same sign basin-wide and can persist for several seasons.

F11183
CARTER D * **Ile Victoria - Pointe Richmond, releves bathymetriques** * 8p * Comm Cap natl * 1982-03.

Dans le cadre de la mise en valeur de l'Ile Victoria, la Commission de la Capitale nationale etudie la possibilite de construire des quais d'accostage soit a l'extremite sud-est de l'Ile Victoria ou de la Pointe Richmond. Cette etude a permis d'etablir une carte bathymetrique essentielle a l'evaluation des sites et a la conception des ouvrages projetes. L'examen de la configuration des fonds ne semble pas indiquer qu'il s'y produit d'importants phenomenes d'erosion ou de sedimentation. Les importantes variations de niveau d'eau commandent une attention speciale dans la conception des ouvrages d'accostage. Ces ouvrages pourront etre des appontements fixes ou flottants. Du point de vue technique, l'extremite sud-est de l'Ile Victoria semble preferable a la pointe Richmond pour l'implantation de quais d'accostage.

063523
CHANASYK DS, VERSCHUREN JP * **An interflow model: II. Model validation** * Can Water Resour J * 8(2) 1-18 * Can Water Resour Assoc, PO Box 250, Kingston, Ont K7L 4V8 * 1983.

The SLUICES model was developed for the purpose of simulating interflow on forested, mountainous watersheds on a distributed basis using a grid system. The Jamieson Creek watershed located in the Seymour River Basin near Vancouver, British Columbia was selected for model validation since interflow plays a dominant role in determining discharge from that watershed. Simulated hydrographs were compared to recorded ones for seven storms, using one storm to optimize parameters. The relationship between grid size and time interval was examined and a relatively simple technique for initializing moisture conditions was derived. Simulations for the storms provided good results, as did those for extended time periods. As a result, the SLUICES model shows promise as an interflow model and its distributed nature gives it flexibility.

063291
CLARKE JW * **Softwater development and applications of the T.I.99/4A micro computer** * IWD-AR-WRB-83-43 * 5p * Environ Can, Inland Waters Dir, Atl Reg, Water Resour Branch, Dartmouth, NS * 1983-03.

In 1982 two T199/4A computers, by Texas Instruments, replaced programmable calculators at the Fredericton and Dartmouth offices of the Water Resources Branch, Inland Waters Directorate. The following programs have been developed, tested and implemented: MM, to compute streamflow notes; Request 2, which produces monthly reports of data requests; Summary, which calculates Unit Runoff for a specific basin; Curve, which calculates best fit curve by the Least Square Method; Transmission, a series of programs which can send to and receive from a Cyber Computer System; and Inventory, used at Fredericton to

maintain inventory listings.

065331
DEWOLFE DL * **Modelling and forecasting of the river flow at Wilmot, N.S.** * 12p * Discovery Consult Ltd, PO Box 599, Wolfville, NS B0P 1X0 * 1983-03.

There are a number of ways by which forecasts of a parameter may be accomplished, ranging from the very simple to the very complex. The subject of this report is the forecasting of the discharge of the Annapolis River at Wilmot by a simple means known as the Box-Jenkins method. The algorithm that is used makes use of the present and recent past values of the river flow to forecast the future values for a number of hours ahead.

062278
DRUCE DJ * **Operational runoff forecasting for the Revelstoke project** . IN: Int Symp on Real-time Operation of Hydrosystems, June 24-26, 1981, Univ Waterloo, Waterloo, Ont, Proc, Vol II * UNNY TE, MCBEAN EA * 726-740 * Univ Waterloo, Waterloo, Ont * (1981).

The Revelstoke Dam presently under construction, is located on the Columbia River in Canada about 80 miles downstream from the Mica Project - a 1740 MW powerplant combined with a 12 maf storage reservoir. The discharge capacity of the diversion facilities at Revelstoke was reduced from 110,000 cfs to 85,000 cfs at the final design stage as a result of the decision to implement a more flexible operational strategy for the Mica Project. The strategy, which attempts to maximize economic benefits and safety by coordinating the releases from the Mica Project with the unregulated runoff from the area downstream relies heavily on the input provided by runoff forecasts. Experience gained over the past three years of operational runoff forecasting has shown that the streamflow data collected on a real-time basis not only affects the accuracy of the forecasts, but could also govern the type of model used for forecasting.

063683
EDDIE JD * **Temporal variation of southwestern Ontario streamflows and the possible influence of agricultural land drainage** * Water Resour Pap 15 * 18p * Hydrol Monit Sect, Water Resour Branch, Ont Minist Environ, Toronto, Ont * 1982.

Temporal variation of streamflows in southwestern Ontario was examined over a 30-year period (1950-1979). Changes in flow regime were sought which might be attributed to the effects of agricultural land drainage. Annual mean, annual maximum, and annual minimum daily streamflows for five representative long-term stations failed to exhibit any discernible consistent trends, fluctuating instead about the period mean in a reflection of annual precipitation patterns. Five stations located in smaller basins, and more likely to reflect the impact of agricultural drainage, showed similar results for the longest common period of record available (1967 to 1979).

065800
ENGEL P * **Critical mean velocity for open channel flow over coarse bed material** * Natl Water Res Inst unpublished manuscr #83-14 * 29p * Environ Can, Natl Water Res Inst, Inland Waters Dir * 1983-09.

Using dimensional analysis it was shown that the dimensionless critical mean flow velocity is a function only of the relative flow depth when the flow is fully rough turbulent. This made it possible to develop a theoretical equation for the critical flow velocity using the Karman-Prandtl logarithmic velocity distribution. Comparison of this equation with those proposed by others showed that it gave the most reliable estimates of critical flow velocity for all depth to grain size ratios greater than 10. The equation was used to develop a critical velocity diagram which can be used to determine the competent flow velocity when the specific gravity of the bed material is 2.7 which is approximately the value for most river gravels and coarse sands.

F12097
ENVIRON CAN, DIR GEN EAUX INTER * **Comptes rendus de l'atelier sur l'echange d'informations d'ordre technologique, programmation lineaire et debits du reseau: mise en pratique, Hull (Quebec), les 15 et 16 septembre 1981** * Etude no 3, Ser ateliers tech * 128p * Environ Can, Dir gen eaux inter, Ottawa, Ont * 1982.

Le but de l'atelier etait d'ameliorer l'habilete, l'efficacite, et la competence de la Direction generale des eaux interieures a remplir ses responsabilites reliees a la gestion des eaux en: transferant au personnel des systemes, du genie, de la gerance et de la science les connaissance et l'experience acquises durant les annees recentes dans l'application reussie de la programmation lineaire et les debits du reseau; corrigeant plusieurs des malentendus generalement entretenus par les specialistes canadiens des ressources en eau concernant les techniques de la recherche operationnelle telles que la programmation lineaire et les debits du reseau; et identifiant les priorites pour les applications futures des techniques de la recherche operationnelle. Le compte rendu se divise en trois parties. La premiere consiste en trois modeles documentes discutes a l'atelier. La deuxieme partie presente un sommaire de la discussion d'un groupe d'experts et de leurs recommandations. La troisieme partie est un appendice qui contient du materiel technique decrivant la programmation lineaire, la programmation

separable, et les debits du reseau. Lloyd Parker, avec l'aide de Don Farley, a revise ce materiel pendant l'atelier. Un ensemble separe des documents et des illustrations visuelles employes par M. Parker etait envoye a chaque participant a l'atelier.

063325
ENVIRON CAN, INLAND WATERS DIR, WATER RESOUR BRANCH, HYDROL DIV * **Natural flow, Eyehill Creek at Alberta - Saskatchewan boundary** * 20p * Environ Can, Inland Waters Dir, Water Resour Branch, Hydrol Div, Calgary, Alta * 1982-09.

The results of this study confirm that the terms of the 1969 Master Agreement on Apportionment were not violated on an annual basis in the Eyehill Creek Basin at any time during the period 1912-1980. In fact, the net depletion of streamflow in the Alberta portion of the basin did not exceed 18% of the natural flow at the interprovincial boundary in any March-October period. The present (1980) level of water resources development in the Alberta portion of the Eyehill Creek Basin would not cause an annual violation of the 1969 Master Agreement on Apportionment, even in the driest of years. With the present level of development, including all licensed, authorized and unauthorized projects, the net depletion of streamflow in the Alberta portion of the basin would not have exceeded 32% of the natural flow at the boundary in any March-October period. At a time when apportionment of flow in Eyehill Creek becomes necessary, serious consideration should be given to investigating alternative stream gauging sites, augmenting the available water use data, and reviewing the delineation of the effective drainage basin.

064737
ENVIRON CAN, WATER MANAGE SYST DIV * **Documentation manual of network configuration and cross-sections for 1-dimensional hydrodynamic model of the Peace-Athabasca Delta region and the Slave River (from Peach Point to Mountain Rapids)** * vp * Environ Can, Water Manage Syst Div, Place Vincent Massey, Hull, Que * 1983-08.

The 1-dimensional hydrodynamic model was used in the preparation of these compiled reports prepared during the period August 17, 1982 to August 30, 1983 dealing with Peace-Athabasca Delta modelling. The reports cover: analyses of the performance of the weirs; study of proposed Slave Dam; Fond du Lac diversion; and expansion of model configuration to simulate overflow through Baril Lake.

066102
FOK ATK, MCNEELY DK, PERKS AR * **A hydrotechnical study of a river snow disposal facility** , IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * v2 727-740 * Can Soc Civ Eng * (1981).

A study of urban snow disposal into the Ottawa River was conducted by McNeely Engineering Limited and Proctor & Redfern Limited. The feasibility of a proposed snow dumping structure was investigated from a hydrotechnical and general environmental point of view. Due to a relatively rapid and deep flow of water past the proposed site, it was found that the formation of frazil ice and ice jamming was unlikely to occur. In comparison with the environmental impacts of alternative disposal methods, the proposed structure would create only local and short-term effects.

066078
GERARD R * **Regional analysis of low flows: a cold region example** , IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * v1 95-112 * Can Soc Civ Eng * (1981).

Environmentally sensitive engineering design of an industrial development requires an understanding of the minimum flows to be expected in the streams affected by the industrial development. An assessment of the water yield of a catchment also requires this understanding. The determination of these low flows in ungauged streams requires either that flows be simulated using a deterministic precipitation-runoff model or that an attempt be made to regionalize available low flow records. This paper presents the results of a preliminary regional study of the low flow characteristics of streams in the Athabasca Oil Sands area north of Fort McMurray in Alberta. This is an area of boreal forest and thick glacial drift deposits. In addition to the usual catchment parameters, low flows in such cold regions are subject to the special influences of ice formation. These influences are discussed and illustrated in the paper. The method and results of the regional analysis are also presented and discussed. It was found that consideration of the unfrozen stream length, area of lakes and the surficial geology allowed a reasonable accounting of the spatial variation in the low flows of streams in the region.

061898
HIPEL KW * **Geophysical model discrimination using the Akaike information** * IEEE Trans Autom Control * AC-26(2) 358-378 * 1981-04.

A general model building procedure is developed for employing the Akaike information criterion (AIC) to select the most appropriate stochastic model to describe a specified geophysical time series. To demonstrate the effectiveness of the proposed approach to model construction, formulas for the AIC are given for many types of stochastic models and the method is successfully employed for determining the most suitable models to fit a wide variety of data sets which arise in

hydrology and the natural sciences. The AIC is used to discriminate between short and long memory models when modeling annual hydrological time series. An improved constrained autoregressive model is designed for describing yearly sunspot numbers while both stationary and nonstationary linear stochastic models are entertained for modeling a tree ring series. Three types of models are considered for modeling seasonal time series and in a practical application it is shown how to select the most appropriate model to fit to a monthly river flow time series. The model building procedure is also used to select an intervention model that describes the effects of the Aswan Dam on the average annual flows of the Nile River.

061897
HIPEL KW, MCLEOD AI, NOAKES DJ * **Fitting dynamic models to hydrological time series** , IN: Time series methods in hydrosciences * EL-SHAARAWI AH, ESTERBY SR * 110-129 * Elsevier Sci Publ Co, Amsterdam, NL * 1982.

Based upon the physical properties of the phenomena being modelled and valid statistical principles, techniques are presented for fitting dynamic models to hydrological time series. Procedures are devised for properly incorporating one or more covariate series into a dynamic model. Furthermore, when there are missing data points in the series, these can be estimated by including a special type of intervention component in the dynamic model. The efficacy of the model building techniques is clearly demonstrated by designing a transfer function-noise model to describe the dynamic relationships connecting a monthly river flow series in Canada to precipitation and temperature covariate series.

F10479
INGRAM RG * **Observations de courantometrie 1980-1981, rapport de donnees** * 3p * Groupe interuniversitaire de recherches oceanogr du Que * 1981-11.

Le present rapport contient les observations de courantometrie prises dans la riviere Eastmain et la region cotiere adjacente de la baie James, entre mai 1980 et juillet 1981. Toutes les mesures proviennent de courantometries Aanderaa et comprennent la vitesse et la direction du courant, ainsi que la temperature, la conductivite et la pression de l'eau. Les donnees recueillies aux differentes stations sont presentees sous forme de tableaux indiquant la moyenne simple pour chaque variable et la profondeur nominale ou les moyennes s'appliquent.

063526
IRWIN RW, WHITELEY HR * **Effects of land drainage on stream flow** (see chapter 5.1 for complete reference - voir chapitre 5.1 pour la reference complete)

065756
ISMAIL S, HAYWARD DG * **Application of dynamic backwater modeling to Mactaquac headpond - Saint John River, N.B.** , IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * vi 203-220 * Can Soc Civ Eng * (1983).

The operating rule curve for Mactaquac headpond calls for significant drawdown during the spring freshet season. This results in a large reduction in head on the generating units with an associated loss in energy. A dynamic backwater model "SOCH" was utilized to analyze the dynamic characteristics of the headpond and its sensitivity to variation of inflow hydrograph rate of rise, as well as, variation of local inflow patterns. The model was also used to develop a new operating rule curve to maximize energy generation from Mactaquac Plant by increasing the operating head on the turbines with minimum risk of flooding both upstream and downstream of the Mactaquac development. Results indicate that 27000 MWH of energy will be gained annually by using the new rule curve to manage the headpond during spring run-off season.

066087
ISMAIL S, HUDSON R * **Effects of raising Mactaquac headpond water level on the hydraulic characteristics of the Saint John River - N.B.** , IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * vi 307-326 * Can Soc Civ Eng * (1981).

The New Brunswick Electric Power Commission is undertaking studies and negotiations relative to the plan to increase the operating water level at the Mactaquac dam to 133 feet (40.5 m) AMSL from its present level of 130 feet (39.6 m). Backwater analysis was utilized to determine the effects of raising the operating water level at the dam on the water levels along the river reach between Beechwood tail race and Mactaquac dam, sediment movement characteristics in the Hartland Salmon Pool, and future flooding potentials downstream of the dam. The analysis of ice formation, ice breakup and ice jams in the headpond are very complex. However, qualitative overview of ice phenomena after raising the water level in the headpond is presented.

066594
JAMES W, SCHECKENBERGER R * **Application of a kinematic storm model to runoff modelling** * 18p * 1982-05.

Spatial and kinematic characteristics of rainstorms are not generally accounted for in runoff modelling. These properties are especially important in high intensity, short

duration summer thunderstorms. This type of rainfall event often contributes to urban flooding, combined sewer overflows and highly concentrated contaminated storm run-off events. A design storm methodology using kinematic storms for the practical design of hydrological systems is investigated. An initial model incorporating spatial and kinematic aspects of thunder storms when used with the Stormwater Management Model provided improved estimates of peak flows, volumes of flow and pollutant loadings. The initial model assumed long thunderstorm cells propagating sub-parallel to the major axis. Present research is focusing on the third dimension to the rainfall model. Relationships between total precipitation and peak intensity, wind direction and storm direction, wind velocity and storm velocity as well as hyetograph rising limb coefficient and recession coefficient, are examined. Because of higher time and space resolution required in urban runoff modelling, highly accurate, sensitive and inexpensive microprocessor-based rain-gauges have been developed. These rain-gauges cost less than $100. The gauges were used during the 1981 summer field program and are presently undergoing tests at the Canada Centre for Inland Waters. Further development of the instruments for on-line control of flooding problems is discussed.

063324
KRISHNAPPAN BG * **Modelling of unsteady flows in alluvial streams** * 26p * Environ Can, Natl Water Res Inst, Hydraul Div, Environ Hydraul Sect, Burlington, Ont * 1983-01.

A computer model to predict the unsteady and non-uniform flows in alluvial streams is described. The model uses a generalized expression for evaluating the energy slope in mobile boundary flows. Therefore, it is possible to adopt different friction factor relationships into the model without affecting the structure of the model. It is also possible to update the model easily as new expressions for alluvial bed roughness become available. The model has been tested for laboratory and field conditions. The model predictions showed a good agreement with the measured data. The model is capable of predicting the long-term changes in river bed slope and, therefore, it is well suited for estimating the possible changes in river regime because of certain modifications to the river flow resulting from such projects as river diversions, meander cut-offs, river training and alignment and dams and hydroelectric power plants.

064082
LOGAN LA, LENNOX WC, UNNY TE * **A residual noise model for streamflow prediction** * Can J Civ Eng * 10(3) 437-449 * 1983-09.

A nonlinear, conceptual hydrologic model is formulated for use in predicting flows under conditions of controlled input. The model has time-invariant parameters and a residual noise model is incorporated for sequential prediction of hourly flows using a closed loop feedback scheme with hypothetically controlled inputs which are adapted to the residuals. The residual model derived comprises error terms which are correlated in time and variable. It is concluded that the residual noise model approach using an input control adjustment algorithm with adaptation to the model residual, produces satisfactory improvement in flow prediction compared with deterministic predictions using physically measured inputs.

F10541
LOUETTE R * **Mesures hydrologiques 1981-1982, releves bathymetriques, sondages acoustiques, site: Caniapiscau aval chute Granite, km 392,70 a 397,0** * 4p * Soc energie de la Baie James, Montreal, Que * 1981-10-10.

Presentation des resultats bruts des sondages acoustiques effectues entre juin et septembre 1982 a proximite de la chute Granite dans le troncon aval de la riviere Caniapiscau sur le territoire de la Baie James.

065473
MACKIE GL, ROOKE JB, ROFF JC,GERRATH JF * **Effects of changes in discharge level on temperature and oxygen regimes in a new reservoir and downstream** (see chapter 4.5 for complete reference - voir chapitre 4.5 pour la reference complete)

065630
MACLAREN LAVALIN, DARTMOUTH, NS * **Annapolis tidal power project task no. 3: flow forecasting phase II report** * 54p * MacLaren Lavalin, Dartmouth, NS * 1982-04.

Forecasts of inflow to the headpond of the Annapolis Royal Tidal Power Project are eventually required on a 10 minute time step for periods of 4 to 12 hours ahead. To meet this need, the only feasible approach is to use a computer based system. This, the second phase in the flow forecasting study, involves the development and testing of a model in a real-time forecasting mode and the refinement of the conceptual design of the associated instrumentation and the data collection network. Section 2 of the report defines the combination of the HYMO model and a simple moisture accounting model that was developed by MacLaren using FORTRAN computer language. In section three, the data collection, transmission and flow forecasting system are developed to meet the real-time requirements of the Nova Scotia Tidal Power Commission. As a result of this analysis five remote stations within the basin have been proposed for field monitoring. Preliminary testing of the model in a real-time forecasting mode using existing data from the Wilmot sub-watershed show fairly

good agreement between observed and forecasted flows. Testing of the model over the remaining areas should be a priority once a reasonable amount of data have been collected.

065637
MARTEC LTD * **Annapolis tidal power basin water level study** * 70p * Martec Ltd, 5670 Spring Garden Rd, Halifax, NS * 1980-05.

This study investigates the variability of basin elevations in relation to tide and river flow conditions, as well as identifies structures which would be adversely affected by higher than average water levels associated with the Tidal Power Project. During the field program the basin elevation was to be raised to the proposed summer maximum operating level of +1.83 metres above geodetic datum to provide a practical demonstration of the water levels in relation to the marsh body surfaces and other man-made structures that potentially could be affected. Data on basin bathymetry, salinity, and marsh soil chloride and water content were collected and are included in this document. Although river flows were insufficient to raise the basin to the proposed levels, the relationship of factors controlling basin elevation and slopes were able to be determined. It was concluded that slopes induced by river flow are only important when flows exceed 70 cubic metres per second. Given the annual river hydrography and the fact that there were no structures or facilities identified where the elevation was only marginally above either the proposed summer or winter operating level maxima, the study findings indicate that potential slope does not have to be considered in designing remedial works to protect vulnerable structures or marsh bodies. Spot checks when water levels are higher is recommended on some of the marsh bodies to identify any back watering, or inundation, of drainage structures, or drainage ditch crossings.

065500
MCLEOD L * **Lethbridge Northern Irrigation District discharge data for 1979** * Data Bull 80-1 * 25p * Alberta Environ, Environ Eng support Serv, Tech Serv Div, Surv Branch * 1980-03.

In 1978 a program for obtaining total flows and losses was carried out at three locations along the L.N.I.D. canal system. The data from two other sites were not obtained due to a blockade by the Peigan Indians. The data from the Water Survey of Canada Station number 05AB016, namely L.N.I.D. canal at Menzaghies Bridge were also used. In 1979 a two-year agreement was signed between the Alberta Government and the Peigan Indians for access to the L.N.I.D. headworks. This permitted the water level recorders at the two sites on the Reserve to be put into operation. These two recorders, along with the one at Menzaghies Bridge, made a total of six recorders along the canal system giving continuous records. Canal flow measurements were also carried out at each site during the irrigation period. Water started to flow in the L.N.I.D. canal system on May 16, 1979 and shut down on October 21. The purpose of this report is to present all the information collected at each site in a convenient package. The stations are numbered arbitrarily for convenient use in this report only. The actual station numbers are based on Water Survey of Canada's numbering system (shown in parentheses). The stations are shown on the layout map at the beginning of the report with station number one being the furthest upstream and station number seven being the furthest downstream. In addition to the basic data there is a brief discussion of the results with respect to losses and total flows in the L.N.I.D. system.

F10612
MESSIER D * **Mesures de la salinite et des niveaux de l'eau dans la riviere Koksoak en 1981** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

F11660
MONFET J * **La construction d'un hydrogramme unitaire synthetique** * H.P.-53 * 19p * Minist environ du Que, Dir gen inventaires et recherche, Quebec, Que * 1981-08.

Bien des travaux d'amenagement exigent des interventions au niveau du reseau d'ecoulement des eaux; il devient alors important de bien connaitre le debit lors des crues et sa repartition dans le temps. Ce travail tente d'apporter un element de reponse en vue d'evaluer le debit de pointe et la forme de l'hydrogramme pour les petits bassins versants du Quebec meridional lors des crues d'orages. Les methodes hydrometeorologiques sont previlegiees dans cette etude; le debit de crue d'une recurrence donnee est associee a la pluie de meme recurrence. La disponibilite des donnees pluviometriques et la facilite relative de transposer la pluviometrie d'un endroit a l'autre sont les principales raisons qui expliquent l'utilisation de ces methodes. Apres avoir presente la methodologie et decrit les differents bassins etudies, les resultats obtenus sont analyses et discutes. Un exemple d'application (riviere Salvail) est egalement presente.

065845
ONT MINIST ENVIRON, WATER RESOUR BRANCH, HYDROL MONIT SECT * **A feasibility study for augmenting Avon River flow by ground water** * Stratford/Avon River Environ Manage Proj Tech Rep S-13 * 60p * Ont Minist Environ, 985 Adelaide St S, London, Ont N6E 1V3 * 1982.

This report considers the feasibility of using ground water to augment stream flow in

the Avon River. A review of existing well records and geologic maps of bedrock and overburden was undertaken. Ground-water chemistry was assessed by a sampling and analysis program for area wells. Results show that sufficient quantities of water might be available from bedrock sources near the river to provide for augmentation of 1 to 3 cfs. Pilot studies to identify well sites and assess well yields and interference problems would be required as part of further studies. As a cost reducing measure, the possibility of augmentation from Stratford city wells could be explored. Based on ground-water and stream-water chemistry, the use of ground water for flow augmentation would serve to dilute most water quality constituents thus improving water quality. (Work undertaken subsequent to the completion of this report indicates that an acceptable level of dilution for phosphorus would require in excess of 25 cfs or 9,000 gpm of augmentation, compared to the 1 to 3 cfs considered necessary at the time of the study documented in this report. In view of the much larger amounts of water now considered necessary, it is considered unlikely that bedrock aquifers in the study area could practically provide this level of augmentation.)

063419
PATRY GG, MARINO MA * **Nonlinear runoff modeling: parameter identification** * J Hydraul Eng * 109(6) 865-880 * 1983-06.

A nonlinear functional rainfall-runoff model is applied to an urban watershed (Curotte-Papineau, Montreal) and the results are compared with those from the ILLUDAS model. Simulations are performed using a 5-minute time interval in order to better define the characteristics of the hydrographs. Particular emphasis is placed on the identification of the most appropriate set of model parameters, namely the memory of the catchment (U) and the order of expansion of the first- and second-order kernels M1 and M2. Parameter identification based on calibration results alone can lead to unpredictable verification (prediction) results; while calibration results improve with increasing values of M1 and M2, verification results do not exhibit the same consistency. Consequently, a two-way calibration-verification analysis is recommended for obtaining the best set of model parameters. Further, results of the nonlinear functional runoff model compare favorably with those of the ILLUDAS model.

062921
RAJARATHNAM N, NWACHUKWU BA * **Flow near groin-like structures** * J Hydraul Eng * 109(3) 463-480 * 1983-03.

This paper presents the results of an experimental study on the structure of turbulent flow near groin-like structures. Based on experimental observations, the deflected flow has been analyzed using the model of the three-dimensional turbulent boundary layer. The flow bounded by the separating stream line, the groin, and the adjacent bank has been analyzed by treating it as a shear layer in which the velocity profiles have been found to be similar. The amplified bed shear stress near the groin has also been analyzed using the similarity idea. Even though the majority of the present experiments were done with the thin-plate groin, some observations were also made on a groin with a semicylindrical hose.

066977
RAO AR, KASHYAP RL, MAO LT * **Optimal choice of type and order of models for riverflow time series** . IN: Decision making for hydrosystems: forecasting and operation, Int Symp on Real-Time Operation of Hydrosystems, Waterloo, Ont, 24-26 June 1981 * UNNY TE, MCBEAN EA * 349-369 * Water Resour Publ, PO Box 2841, Littleton, CO 80161 US * 1982.

The performance of various types of models for riverflows are compared using a decision rule derived from the Bayes criterion. The decision rule has the property that it minimizes the probability of error. The best model among the AR, ARMA and MA models of various orders for the annual flows of about 10 rivers is found by using this decision rule. For the monthly flows, not only the best seasonal ARIMA model but also the best type of transformation is determined. The models for the log-transformed monthly data are superior to the models fitted to the observed data without transformation. The variability in the decisions caused by the different prior probability density functions is discussed.

F11331
SANGAL BP * **Methode pratique pour l'estimation des debits de pointe a partir des debits journaliers moyens et application a des cours d'eau de l'Ontario** * Rapp no 16 de l'INRH, Etude no 122, Collect rapp tech de la DGEI * 242p * Environ Can, Inst natl rech hydrol, Dir gen eaux inter, Ottawa, Ont * 1981.

Le present rapport propose une methode pratique d'estimation des debits de pointe. Les variables employees sont les debits journaliers moyens de trois jours consecutifs, le debit journalier moyen maximal occupant la position mediane. Un parametre ayant une valeur entre zero et deux joue le role de facteur de base (K); ce parametre a une influence determinante sur l'estimation du debit de pointe. Dans l'equation de prevision employee, on a pose K egal a 1. La methode a ete appliquee a des cours d'eau de l'Ontario dont le bassin de drainage a une superficie de moins de 1 km carre a plus de 100,000 km carre. Au total, 387 stations equipees de debitmetres enregistreurs ont participe. Au

cours de la periode d'observations se terminant en 1979. 3946 pointes ont ete enregistrees. Les ecarts entre les valeurs reelles et les valeurs prevues ont ete de plus ou moins 10% dans environ 57% des cas et de plus ou moins 20% dans environ 79% des cas. Environ 62% des pointes prevues depassaient les valeurs reelles. Le parametre K doit etre pour les crues dues aux precipitations dans les petits cours d'eau. Sa valeur est generalement inferieure a un dans ce cas. On propose des methodes pour son estimation.

062050
SCHAFER CT, SMITH JN * **River discharge, sedimentation, and benthic environmental variations in Miramichi Inner Bay, New Brunswick** * Can J Earth Sci * 20(3) 388-398 * 1983-03.

Sequential studies of benthonic foraminifera in the Miramichi estuary, New Brunswick over a 12-year period indicate that a "transitional" foraminiferal assemblage, which defines a zone of interaction of river and open bay environmental factors, has developed in Miramichi Inner Bay since 1964. Abundance variations of the transitional foraminiferal indicator species, Ammotium cassis relative to Miliammina fusca (upper estuarine indicator) and Elphidium excavatum forma clavata (marginal marine indicator) in short cores suggest that the regional extent of this transitional thanatotope in the western part of Miramichi Inner Bay has varied considerably during the past 80-100 years. These changes appear to be related to total annual river discharge variations, competence of the Miramichi River system, and, possibly, changes in the tidal circulation pattern of bay water. Tidal circulation may have been altered by the location and cross-sectional area of several channels that occur between the barrier islands on the seaward side of the bay.

066110
SKAGGS RL, WALTERS WH * **The application of an unsteady flow numerical model to extreme low flow conditions** , IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * v2 911-924 * Can Soc Civ Eng * (1981).

The purpose of tha paper is to present a discussion of the problems encountered in the mathematical modeling of low flows in stream channels. The model evaluated is the full dynamic wave model. This model is normally applied to high flow events and is a proven flood routing technique used to determine the time and magnitude of peak flows along a specified river length. More recently, because of interest in stream channel transport of contaminants, there has been an increasing need to simulate lesser flow events and low flow periods. This paper discusses the application of a model to a small stream under unsteady low flow conditions. The major problems appear to be the representation of the surveyed channel geometry and the significant changes in cross-sectional area and slope. Too much detail can present critical problems when attempting to simulate low flow conditions. This leads to the conclusion that any data collection program needs to be tailored to the model or models to be used. The necessary steps for applying the model is presented including preparation of data for model input, model calibration and interpretation of results.

062910
STEER P, WOO MK * **Measurement of slope runoff in a permafrost region** * Can Geotech J * 20(2) 361-365 * 1983-05.

Installations at a High Arctic experimental site that is underlain by continuous permafrost allowed the measurement of slope runoff. Surface flow was collected near the base of the slope and the water was led to a flume with a V-notch weir. The water level in the flume was recorded and subsequently converted to discharge measurements. Subsurface flow was intercepted by an impermeable flow barrier set in a trench dug down to the permafrost table and later back-filled by the excavated slope materials. Water draining from above the flow barrier was fed into another flume unit similar to that for surface runoff. During the operational period, regular inspection of the flumes was required to ensure the prevention of ice formation or evaporative losses from the water in the flumes.

067081
SYDOR M * **Real-time discharge prediction and field verification of the Fraser River one-dimensional model with the moving boat technique** , IN: Can Soc Civ Eng 1983 Annual Conf, Proc, Recent Developments in Computer Applications in Civil Engineering, June 1-3, Ottawa, Ont * 109-127 * Can Soc Civ Eng, Comp Appl Div * (1983).

This paper discusses the methodology to derive flow discharge input for sediment computations in the Fraser River network using computers and computer monitoring devices. The study reach chosen, in the lower Fraser River, is one which has for years been carefully gauged so as to compute sediment transport. Several previous attempts to mathematically model this complex river network were unsuccessful. A One-Dimensional Mathematical Model in conjunction with the Moving-Boat Technique, has demonstrated an effective method of discharge measurement that is not only fast but also results in a high degree of accuracy. Present efforts at computing sediment load will now become easier as river discharges can be more precisely predicted.

06b753
TAMBURI AJ, SHEWFELD B, POMALAZA J * **Width-depth studies of the Mississippi River**, IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * v1 147-163 * Can Soc Civ Eng * (1983).

Width-depth techniques developed on the Fraser are applied to a reach of the Mississippi River. The techniques are used to assess channel stability, scour processes, equilibrium conditions, divided flow reaches and the impact of top width on cross sectional area. Progress is also made towards developing bedload equations on the basis of sounding data.

062546
TAYLOR CH * **The effect on storm runoff response of seasonal variations in contributing zones in small watersheds** * Nord Hydrol * 13(3) 165-182 * 1982.

Storm runoff production by saturation overland flow has been studied in two small watersheds in south-central Ontario. One is in rural land use and contains a wetland. The total saturated zone is at its maximum extent during spring snowmelt, when the overwhelming majority of total runoff and quickflow is produced. The stream seldom flows during the summer and winter seasons but does so occasionally in the fall if the wetland is recharged sufficiently. Simple calculations show that storm-to-storm variations in quickflow response are controlled by the extent of surface soil saturation (measured by field mapping and correlated with antecedent wetness variables) and precipitation amount. The other watershed has been undergoing suburban developement since 1973. Quickflow response during summer and fall seasons has not changed noticeably since then, although 30% of the watershed surface has been disturbed. This is because in those seasons quickflow is still produced as saturation overland flow from the original contributing zones alongside the stream. In contrast, during spring snowmelt the very wet soil conditons and a high water table allow the disturbed surfaces with low infiltration capacities to be integrated into the contributing area via normally dry drainage lines. As a result spring quickflow has increased by three to four times over the original values.

065158
THORSON KM * **Interim compilation of stream gauging data, 1979** * 63p * Alta Environ, 15th Floor, Oxbridge Place, 9820-106 St, Edmonton, Alta T5K 2J6 * 1980-08.

The present report is an update of the previous report, "Interim Compilation of Stream Gauging Data, 1978" (Project HY 1.1), and contains all available hydrometric data for the study area for the 1979 calendar year. Presented are daily discharges for streamflow stations with corresponding hydrographs and stage-discharge curves and water level information for gauged lakes.

066673
WATER PLANN MANAGE BRANCH AND WATER RESOUR BRANCH, ENVIRON CAN * **Fraser River model study, the application of a 1-dimensional hydrodynamic model to the lower Fraser River** * 5v * Environ Can, Water Plann Manage Branch and Water Resour Branch, Ottawa, Ont * 1983-06.

The intent of this report is to bring to a conclusion the results of four field data gathering exercises that were instrumental in providing the 1-Dimensional model with instantaneous discharges under tidally induced unsteady flow conditions. The data were used to calibrate and later confirm the operation and simulation capabilities of the 1-Dimensional model. It is demonstrated that flows at Port Mann, computed through the operation of the calibrated model, are suitable with respect to accuracy and frequency for use in the computation of suspended sediment loads. As well, additional knowledge has been gained in determining the change in roughness in the sediment-laden main Fraser channel, the extent and timing of movement of sediments in the Pitt River, the minor variations in stages that randomly occurred at the Mission station, and the ability to correct or point out errors in other gauging points which serve as vital checks or as input to the model. The error in flow simulation on a daily basis is less than 5%, while on an instantaneous basis it averaged 8% or less. The model has been demonstrated to operate under large tidal variations and in low, medium and high flow conditions. The results are extremely encouraging and knowledge gained on the Lower Fraser would be definitely transferable to other similar situations in Canada.

066639
WAYLEN PR, WOO MK * **Stochastic analysis of high flows generated by mixed processes** * Can J Civ Eng * 10(4) 639-648 * 1983-12.

Existing stochastic models describing the probability distributions of the magnitude, duration, frequency, and timing of high flows resulting from a single flood-generating process are expanded to accommodate the more generalized case of mixed-generating processes. The proposed method is simple to apply and retains a theoretical and physical basis. The ability to predict high flows at any higher truncation level of interest without resorting to reanalysis of the historical data is presented. The methodology is applied to three basins in southwestern British Columbia that experience both snowmelt and rainfall generated floods. Good agreement between the data derived for the partial

duration series of the study basins and the predicted distributions illustrates the general applicability of the technique.

063626
WAYLEN PR, WOO MK * **Stochastic analysis of high flows in some Central British Columbia rivers** (see chapter 4.2 for complete reference - voir chapitre 4.2 pour la reference complete)

061856
WOO MK, STEER P * **Occurence of surface flow on arctic slopes, southwestern Cornwallis Island** * Can J Earth Sci * 19(12) 2368-2377 * 1982-12.

Surface flow on arctic slopes is due to a rise of the suprapermafrost water table above the ground surface. The active layer therefore has to be saturated, or surface flow will be lost to infiltration. In spring, snowmelt supplies abundant water to the slopes, but a shallow frost table restricts the active layer storage capacity. This produces extensive surface flow, delivering considerable volumes of water downslope as overland flow or rill runoff. As the snowpacks are reduced and ground thaw increases the subsurface storage capacity, surface flow declines in magnitude and in areal coverage. During most summers, subsurface flow dominates, except when occasional rainstorms of high intensity raise the water table above the ground to rejuvenate surface runoff. The occurrence of surface flow is controlled by slope material, slope profile, and the water balance. Spatial and temporal changes in these controlling variables always result in a highly dynamic pattern of surface flow on arctic slopes.

4.2 Floods and High Flows - Crues et inondations

062287
ANDRES DD * **Okotoks floodplain study** * 25p * Alta Environ, Environ Eng Support Serv, Tech Serv Div * 1981-04.

The Sheep River at Okotoks drains an area of 1476 sq km and is fed by the Upper Sheep River and Threepoint Creek which drain both the high mountain and foothills area to the west. The Town of Okotoks has experienced significant floods on a number of occasions since settlement began near the end of the last century. The 1932 flood, for example, is estimated to have been 170 cu m/sec and was a 1:500 year event. The most recent floods, 1963 and 1967, were approximately 1:12 year events and both caused damage. The instantaneous peak discharge for a median annual flood and a 1:100 year flood have been computed to be 57 sq km/sec and 1190 sq km/sec respectively. The 1:100 year flood peak will inundate most of the valley between the south valley wall and the CPR tracks, except for some lots which border the CPR right-of-way between Highway 2A and the arena. These tracks are overtopped west of the town and flood waters enter the town by flowing down-valley along Elizabeth Street. It is also possible that the railway tracks can be overtopped east of town near Lineham Avenue. This report contains an areal delineation of the 1:100 year flood level and water surface profiles for the 1:100, 1:50, and 1:20 year events. Some hydrologic, geomorphic, and hydraulic characteristics of the Sheep River are also discussed.

062522
ASHKAR F, ROUSSELLE J * **The effect of certain restrictions imposed on the interarrival times of flood events on the Poisson distribution used for modeling flood counts** * Water Resour Res * 19(2) 481-485 * 1983-04.

In the application of partial duration series models of flood analysis it is occasionally observed that successive exceedances are correlated. To reduce this correlation, some investigators tend to impose certain restrictions on the interarrival times of flood events in order that these events will not occur close together in bunches. We show analytically how such restrictions interfere with the underlying hypotheses of the Poisson process commonly used to model flood counts, and we caution against imposing restrictions that may render this simple and appealing model inapplicable.

062521
ASHKAR F, ROUSSELLE J * **Some remarks on the truncation used in partial flood series models** * Water Resour Res * 19(2) 477-480 * 1983-04.

In the partial duration series approach to the problem of flood analysis, the truncation level above which streamflow is regarded as flood flow plays a key role. In the absence of a systematic and well defined method for selecting such a level in practice, it is desirable to know how different choices effect the obtained results. We base our mathematical investigation on some commonly used partial flood series models to show that once the time-dependent Poisson process, used in modeling flood frequency is found applicable with a certain truncation level, then it should remain so with any higher truncation level. We also point out that this same property holds true for the exponential distribution widely used in the study of flood magnitude. At the end of our investigation we give a number of remarks on some problems involved in the practical application of partial duration series models.

063769
BARKER ML, MORGAN WB * **Shore and floodplain management in British Columbia and Washington State, Chapter 8** , IN: Water problems and policies * SEWELL WRD, BARKER ML * Cornett Occas Pap No 1 * 49-68 * Dep Geogr, Univ Victoria, Victoria, BC V8W 2Y2 * 1980.

Major differences between the shore- and floodplain-management approaches of British Columbia and Washington State lie in the extent of formal administrative arrangements, and the relative roles of the federal and regional governments. In Washington State, integrated shore resource management is practiced within a state-approved local plan and permit system. The Program receives federal funding support as it meets the standards set by the United States Coastal Zone Management Act. Shore management in British Columbia is confined to provincial initiatives taken in specific problem areas. The multiplicity of federal and provincial agencies with specific resource orientations has inhibited the development of a province-wide policy, although referral and liason systems have served as an integrative role in specific problem areas.

063175
BEAUDOIN P, ROUSSELLE J, MARCHI G * **Reliability of the design storm concept in evaluating runoff peak flow** * Water Resour Bull * 19(3) 483-487 * 1983-06.

A comparative study was undertaken to evaluate peak runoff flow rates using (1) a continuous series of actual rainfall events and (2) design storms. The ILLUDAS computer mode was used to simulate runoff over a catchment within the city of Montreal, Canada. A ten-year period, five minute increment rainfall data base was used to derive peak flow frequency curves. Two types of design storms were analyzed: one derived from intensity duration frequency curves (Chicago type), the other from averaging actual rainfall patterns (Huff type). Antecedent soil moisture conditions were considered in the analyses. It was found that the probability distribution of runoff peak flow was sensitive to the choice of design storm pattern and to the antecedent soil moisture condition. A symmetrical, Chicago-type design storm with antecedent dry soil moisture produced a flow frequency curve similar to the one obtained from a series of historical rainfall events.

064865
BECKSTEAD GRE, JACKSON JE * **Pincher Creek floodplain study** * 17p * Alta Environ * 1980-10.

This report contains a floodplain delineation of Pincher Creek at the Town of Pincher Creek. Hydrometric data for the 159 sq km basin have been analyzed to determine the 100-year flood (210 cu m per s). A computer model of Pincher Creek has been formulated and calibrated from a known water surface elevation for the 1975 flood (172 cu m per s). This model was used for computation of water surface profiles for both 100-year and 50-year (170 cu m per s) events). Delineation of the 100-year flood event indicates major flooding downstream and immediately upstream of the Waterton Avenue (Hwy. 6) bridge. Minor flooding occurs on the north bank downstream of the Bridge Avenue and Hewetson Avenue bridges and on the south bank of the floodplain below Rimmington Avenue.

063780
CHOW KCA, WATT WE, WATTS DG * **A stochastic-dynamic model for real time flood forecasting** * Water Resour Res * 19(3) 746-752 * 1983-06.

A stochastic-dynamic model for real time flood forecasting was developed using Box-Jenkins modelling techniques. The purpose of the forecasting system is to forecast flood levels of the Saint John River at Fredericton, New Brunswick. The model consists of two submodels: an upstream model used to forecast the headpond level at the Mactaquac Dam and a downstream model to forecast the water level at Fredericton. Inputs to the system are recorded values of the water level at East Florenceville, the headpond level and gate position at Mactaquac, and the water level at Fredericton. The model was calibrated for the spring floods of 1973, 1974, 1977, and 1978, and its usefulness was verified for the 1979 flood. The forecasting results indicated that the stochastic-dynamic model produces reasonably accurate forecasts for lead times up to two days. These forecasts were then compared to those from the existing forecasting system and were found to be as reliable as those from the existing system.

065745
CONDIE R, PILON PJ * **Fitting the log Pearson type 3 distribution to censored samples: an application to flood frequency analysis with historic information** , IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * 11-22 * Can Soc Civ Eng * (1983).

The series of recorded annual maximum flood peaks together with any historic information is treated as a censored sample from a log Pearson type 3 distribution. The likelihood function is given in terms of the recorded floods, the censoring threshold and the parameters to be estimated. Maximizing the function leads to a set of three simultaneous transcendental equations which when solved give estimates of parameters which reflect the historic information. T-year floods can then be computed.

062559
COTE B, BRUNELLE PE * **Flood routing in rivers by transfer function identification** * J Hydraul Res * 20(5) 415-426 * 1982.

A numerical method of obtaining the transfer function of a single input-output system is presented. The equations are developed in the time domain and the resulting mathematical model reduces to a linear difference equation with constant coefficients. Details such as convergence and numerical particularities are discussed. The model is validated by its application ("off-" and "on-line") to the classic problem of flood routing in a river reach, taking a hypothetical rectangular channel and a 45 km segment of the Gatineau river (Que., Canada) as the testing grounds.

F11910
DROUIN M, TRAN VAN T * **Protection contre les crues de printemps des ouvrages en construction de la phase I du complexe La Grande** , IN: 6e Conf can d'hydrotechnique, comptes-rendus, 2-3 juin 1983, Ottawa, Ont * TOWNSEND RD * v2 891-914 * Soc can genie civ * 1983-06.

La Societe d'energie de la Baie James, agissant pour le compte d'Hydro-Quebec, est responsable de la conception et de la construction des amenagements hydroelectriques de la Baie James. La phase 1 du Complexe La Grande a necessite la derivation provisoire de trois des plus importantes rivieres du Quebec. Ces operations ont ete effectuees de 1975 a 1983. L'article traite des criteres de conception et decrit les crues printanieres survenues au cours de la construction des barrages. Des precisions sont fournies en ce qui concerne en particulier la surexcavation des galeries, la rugosite des parois, la vitesse maximale d'ecoulement, la hauteur des revanches et l'integration de certaines composantes des systemes de derivation provisoire aux ouvrages permanents.

062281
DYKEMA K, FONSTAD GD * **Penhold floodplain study** * 9p * Alta Environ, Water Resour Manage Serv, Tech Serv Div * 1982-03.

This report contains a floodplain delineation for Waskasoo Creek which flows through the Village of Penhold, south of Red Deer, Alberta. Uncorrected air photograph mosaics showing the delineated 1:100 year floodplain are included, as well as a water surface profile allowing the determination of flood elevation and water depths throughout the study area. The wide, flat plain east of the municipal road appears subject to flooding. Several homes in the trailer park, Lincoln Street, and Dundee Crescent also appear flood prone. Block six at the southeast quarter of the Town is also subject to flooding.

061945
EL-JABI N, ROUSSELLE J, BRIERE F, LEBLANC D * **Flood plain management - Hydro-economic analysis** * Sci Ser No 127 * 118p * Environ Can, Inland Waters Dir, Water Plann Manage Branch, Ottawa * 1982.

This study deals with the establishment of an intergrated system which would form the basis of the rational planning of flood plains and would include hydrological, hydrodynamic, physical and economic components. The application of such a system to a region of interest should lead to the establishment of a management policy for river banks, the basic objectives of which may be classified as follows: The analysis of flood/damage relations to obtain probability distribution functions for damages caused by floods; and The estimation of these damages without a post-flood investigation. This helps in the rational planning of zones already urbanized and the adequate management of zones set for future urbanization. A digital simulation approach is taken in which the flood phenomenon and its impact on flood plains are considered as a complex system, which permits the estimation of hydrological characteristics (depth of submersion) for every economic unit in different activity sectors (permanent and secondary residential, agricultural, commercial and industrial). From this, one may correlate floods and flood damage, which can be extrapolated in time and space for various types of physical and non-physical damage. This theory is based on the use of extreme values and the sum of a random number of random variables in a stochastic process. The Richelieu River basin in Quebec, with its rural and urban sectors, has been chosen for a numerical application. The results of this study will contribute to the development of criteria for studying the value of management projects; the judicious choice of a flood control system after criteria, both technical and economic, have been determined; the determination of flood/damage correlation with no need for post-flood investigations; and the integration of urban and rural hydrology to obtain better watershed planning.

062872
FOLSTER ME * **Historical flood review of the Upper Kennebecasis River Basin** * 4p * 1980-07.

This review shows that the extent of flooding which occurs in the Upper Kennebecasis River Basin, and the resulting damage which has been recorded as a consequence of a typical flooding event, is caused by period of prolonged rainfall (60 hours in November, 1854) or periods of intense rainfall lasting 10 hours or more (frequently less than 24 hours). This intense rainfall may or may not be in combination with spring freshet conditions. Indeed, record late summer and fall flooding (August 1922, October 1926, October 1933) caused solely by severe

rainstorms, have "rivalled the highest spring freshet in memory".

065352
FREE BM, MULAMOOTTIL GG * **The limnology of Lake Wabukayne, a storm-water impoundment** (see chapter 4.4 for complete reference - voir chapitre 4.4 pour la reference complete)

062292
GARNER L * **Nose Creek historical high water marks** * 15p * Alta Dep Environ, Environ Eng Support Serv, Tech Serv Div * 1980-04.

This report presents historical information on high water marks on Nose Creek, near Airdrie and Balzac, Alberta. Residents from different areas along the creek were interviewed. Summaries are given of these interviews and they are accompanied by snapshots of some of the flooding events. From these interviews it would appear that flooding along Nose Creek and West Nose Creek were local events caused by heavy rains or ice jams. Upstream of Airdrie appeared to have been very wet and marshy but with agricultural development has changed drastically. Municipal development with roads, bridges, and culverts could have affected flow patterns and alleviated some flooding problems. However, it is believed that weather conditions have changed and this is the reason why Nose Creek has not been subject to any large flows or floods.

065754
GOULTER IC, KIELY DA * **Changes in flood level differences with urbanization - a predictive study** - , IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * vi 165-180 * Can Soc Civ Eng * (1983).

Many previous studies on the effects of urbanization on watershed hydrology concentrated on the modification of peak flow, time to peak flow and volume of runoff. This study investigates the effects of urbanization on the flood stages and in particular the flood stages for the 10 and 100 year flood events on the Spring Creek Watershed in Will County, Illinois. Various patterns of urbanization and modifications to the channel parameters were considered. It was found that modifications to the hydrologic characteristics of land parcels and simple modification to channel roughness did not significantly alter the difference between the 10 and 100 year flood stage. Modification to the channel cross sections by construction of levees did however modify this difference considerably.

066536
GOULTER IC, MORGAN DR * **Analyzing alternative flood drainage reduction measures on small rural watersheds using multiple return period floods** * Water Resour Res * 19(6) 1376-1382 * 1983-12.

In many areas of rural Manitoba, conventional flood control measures such as diking and channel clearing are proving to be ineffective, both in their cost and in their ability to reduce flood damages. A heuristic technique has been developed to assess the economic feasibility of a number of unconventional measures for flood damage reduction. Two measures considered are: (1) substitution of crops with a low susceptibility to flood damage for crops with a high susceptibility to flood damage and (2) storage of floodwaters on poor crop land to prevent flood damage on better crop land downstream. The probability of occurrence of various flood events is incorporated into the technique. The method is based upon the dynamic programming optimization technique and has been developed with particular emphasis on the Wilson Creek Watershed on the eastern boundary of Riding Mountain National Park, Manitoba, Canada.

066971
GRUNDFEST EC * **Assessment of research on individual behavioral response to warnings of extreme events** , IN: Decision making for hydrosystems: forecasting and operation, Int Symp on Real-Time Operation of Hydrosystems, Waterloo, Ont 24-26 June 1981 * UNNY TE, MCBEAN EA * 35-41 * Water Resour Publ, PO Box 2841, Littleton, CO 80161 US * 1982.

More hydrological systems research focuses on improvements in forecasting capability than on the impact the predictions have on reducing loss of life or property damages. This paper pools and analyzes scientific research exploring the relationship between individual awareness of a hazardous situation and timely adaptive action. How strong is the link between belief in a present risk and a change in behavior? What is the necessary time requirement for warning dissemination and adequate individual response? A flash flood situation may allow only 45 minutes leadtime, while a slow rise flood situation may allow several days leadtime. The growing understanding of warning processes shows personality, age, sex, socioeconomic status, group contact and prior hazard experience are among the factors determining belief and response (Gruntfest 1977; Lachman et al 1961). Credibility of source, message content, confirmation, sense of urgency and number of warnings received are warning characteristics which influence changes in activity. Extensive research on organizational warnings and response has recently been completed by a University of Minnesota group (Carter and Clark 1977). In social science, public education campaigns are recommended to

heighten awareness. How does awareness increase the likelihood of adaptive action following a warning or environmental cue? The links between warning and behavior must be better understood, if loss reductions in extreme hydrological events are to be achieved. Not only must individuals recognize the hazard but they also must know what action to take and then be willing to take such actions. Few studies actually examine actions taken by people facing extreme situations (Gruntfest 1977, 1980; Abe 1978). The paper draws on the 1976 Big Thompson flash flood real-time experience and other recent research efforts to illustrate the complexity of the problem. Recommendations for further research and research applications are made.

F11960
HOANG VD * **Synthese des crues pluviales des petits bassins versants du Quebec** , IN: Compte rendu, Colloque sur la modelisation des eaux pluviales, tenu au Holiday Inn Centre-Ville, Montreal, Que, 8-9 sept, 1983 * BERON P, BARNWELL T * Rapp GREMU 83/03 * 16-31 * Ec Polytechnique Montreal & US Environ Prot Agency * 1983-10.

L'estimation du debit de pointe des petits bassins versants revet une tres grande importance pour l'hydraulicien ou pour l'hydrologue dans le calcul du dimensionnement des ouvrages hydrauliques ou la delimination des zones d'inondation par exemple. Cette etude propose un modele d'evaluation du debit de pointe et de la forme de l'hydrogramme pour les petits bassins du Quebec habite lors d'une crue d'orage. Ce modele propose trois etapes distinctes lors de l'estimation du debit de pointe. La premiere etape, consiste a evaluer le volume de precipitation que peut recevoir le bassin selon la duree de la pluie et la periode de recurrence desiree, la deuxieme, le calcul du coefficient de ruissellement et finalement, la derniere etape, consiste a determiner la facon dont la lame d'eau ruisselee sera acheminee vers l'exutoire ou vers le point sur le cours d'eau ou le calcul du debit de pointe est a faire.

066978
HOLLE FK, LEONHARDT P, LUDWIG K * **Flood forecast in river basins with regulation systems** , IN: Decision making for hydrosystems: forecasting and operation, Int Symp on Real-Time Operation of Hydrosystems, Waterloo, Ont, 24-26 June 1981 * UNNY TE, MCBEAN EA * 391-404 * Water Resour Publ, PO Box 2841, Littleton, CO 80161 US * 1982.

River basin models are necessary to analyse runoff processes in river basins with regulation systems to render possible effective flood control measures at potential damage centers. It is proposed to develop flood forecast models from detailed river basin models by simplification of the areal and hydrological features. These detailed models were originally developed for purposes of water resources oriented planning in the river basin.

066970
HOWARD CDD * **Forecasting the effects of severe rainfall runoff on reservoir release routing** (see chapter 4.5 for complete reference - voir chapitre 4.5 pour la reference complete)

062291
HYDROCON ENG (CONT) LTD * **Nose Creek floodplain study** * 25p * Hydrocon Eng (Cont) Ltd * 1980-09-08.

This report delineates the floodplain limits for Nose Creek and its major tributary, West Nose Creek for the 1:100 year (1% frequency) return period flood. The study area is described and peak flows for fifteen locations are listed. A brief review is given of the history of flooding in the area and the creeks are described. The input data and methodology used are described and results are summarized. The summary floodplain delineation of the entire area consists of 13 maps at a scale of 1:5000. Specific comments are made regarding each of the maps. This floodplain delineation study is accurate enough to enable planning of future subdivisions and to enable the assessment of the impact of these developments. Appendices to the report contain detailed floodplain delineation maps and a brief listing of problems encountered.

063766
JESSEN S, DAY JC * **Regulating Great Lakes flood and erosion hazards: the Haldimand - Norfolk experience, Lake Erie, Ontario, Chapter 3** , IN: Water problems and policies * SEWELL WRD, BARKER ML * Cornett Occas Pap No 1 * 13-24 * Dep Geogr, Univ Victoria, Victoria, BC V8W 2Y2 * 1980.

During the 1970s an innovative approach to control flood and erosion hazards was adopted by the regional municipality of Haldimand - Norfolk in Ontario. It was based on the implementation of land-use regulations to control development in hazard-prone coastal areas. The Haldimand - Norfolk experience is evaluated in terms of three criteria: (1) the effectiveness with which further development has been prevented in hazardous shoreline areas; (2) the efficiency of the regional decision-making process in implementing the regulations; and (3) the adequacy of regional institutional arrangements for controlling hazard-susceptible developments. A brief description is given of the study area, its flood and erosion problems, and recent development trends are described. A review is given of the evolution of shoreline protection regulations, their objectives, and implementation. Finally, an evaluation is made of the Haldimand - Norfolk coastal-zone

management system.

065765
JOLIFFE IB * **Generalized method of flood routing computations in channel networks** . IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * 419-430 * Can Soc Civ Eng * (1983).

Implicit finite difference techniques have long been used for flood routing in single channels. A technique for developing a general implicit finite difference network wave propagation model is discussed; this model uses a sparse matrix technique to store and solve the resulting sets of simultaneous linear equations. The proposed model also makes use of simplified expressions for partial derivatives which must be evaluated during the solution process. Numerical experiments show the applicability of the proposed model to a propagation problem; these experiments also demonstrate the sensitivity of the computational scheme to the discretisation of various parameters in the solution.

066082
KLEMES V * **Pruning the models for storage reservoir analysis** (see chapter 4.5 for complete reference - voir chapitre 4.5 pour la reference complete)

061884
KREUTZWISER R * **An evaluation of government response to the Lake Erie shoreline flood and erosion hazard** * Can Geogr * 26(3) 263-273 * 1982.

Human occupancy of hazard land is a subject that has long captured the attention of geographers. But that academic interest is a reflection, in turn, of the considerable social significance of natural hazards. During the 1972-75 high water period on Lake Erie, for example, shore property-owners suffered in excess of $110 million in damages from flooding and erosion, and government agencies spent over $60 million in hazard assistance. Moreover, in spite of increasing attention and expenditures by individuals and governments, damage from the shoreland hazard is increasing. In large part, this appears to be a result of man's ignorance or neglect of important biophysical processes and his increasing encroachment into dynamic shore areas. Unfortunately, too, government policies sometimes contribute to the increased damage, by encouraging continued, and even expanded, encroachment. In this paper, I consider the nature of the Lake Erie flood and erosion hazard problem and describe and evaluate government policy for dealing with this problem on both the Canadian and the American shores. 'Policy' here refers to the total government involvement in the hazard problem, including legislation, regulations, guidelines, incentives, penalties, programmes, and projects. Fundamental to the evaluation is a human ecological approach to natural hazards, in which natural hazards are considered to result from the interaction of biophysical and human elements and processes.

F11956
LAROCQUE M * **Utilisation de SWMM pour la ville de Saint-Laurent** , IN: Compte rendu, Colloque sur la modelisation des eaux pluviales, tenu au Holiday Inn Centre-Ville, Montreal, Que, 8-9 sept, 1983 * BERON P, BARNWELL T * Rapp GREMU 83/03 * 143-158 * Ec Polytechnique Montreal & US Environ Prot Agency * 1983-10.

Suite aux inondations survenues les 1er et 2 septembre 1980 dans le bassin Notre-Dame-de-Grace (NDG), Beauchemin-Beaton-Lapointe Inc. a ete mandate pour etudier les causes des inondations et etablir les solutions requises a court, moyen et long termes. Les simulations des developpements actuels effectuees a l'aide des modeles ILLUDAS et SWMM ont demontre que la capacite de la majorite des bassins NDG et Leduc est depassee pour une pluie de 1/5 ans, et ceci, surtout a cause du fait que le taux d'impermeabilite actuel est plus eleve que prevu. Aussi, les debits de ruissellement y resultant provoquent une surcharge prononcee dans ces deux reseaux. Par l'application des derniers concepts de controle du debit de ruissellement, cette etude permis d'offrir aux ingenieurs de Ville de Saint-Laurent une solution viable et economique comparativement aux solutions conventionnelles, en vue de reduire les risques d'inondation en des proportions raisonnables.

062754
LLOYD RJ * **Coping with the Great Lakes, Flooding and erosion, Part 1: The hazards, Part 2: Avoiding the hazards (audio-visual program)** , IN: Proc Canadian Coastal Conf 1983, Vancouver, 11-14 May 1983 * HOLDEN BJ * 325-326 * Natl Res Counc, Assoc Comm Res Shoreline Erosion Sediment, Ottawa, Ont K1A OR6 * 1983.

As the voluminous reports on the Great Lakes water levels and shore erosion continue to pile up, there has been a common recurring conclusion and recommendation. It appears there is a lack of a clear understanding on the part of the public as to why the lake levels fluctuate and shore erosion occurs. In more recent years most recommendations have centred around better public information programs and the institution of effective coastal zone management practices. To help out in this regard this slide-tape show was produced as part of the Canada-Ontario Great Lakes Shore Damage Survey Follow-up Program. In the Public Awareness segment of the Follow-up Program a concerted effort was made to increase public and planning agencies'

awareness of the hazards of shoreline flooding and erosion. The two part slide-tape show is a graphic fast paced education A-V program. The 152 slides in the 20 minute show were carefully selected from thousands of stock slides and supplemented by additional photography to effectively convey the message. Colourful graphic and special effect slides were also made extensive use of for added impact.

066980
LOGAL LA, UNNY TE, LENNOX WC * **Flood flow forecast with a time varying nonlinear model** , IN: Decision making for hydrosystems: forecasting and operation, Int Symp on Real-Time Operation of Hydrosystems, Waterloo, Ont, 24-26 June 1981 * UNNY TE, MCBEAN EA * 505-525 * Water Resour Publ, PO Box 2841, Littleton, CO 80161 US ISBN 0-918334-50-0 * 1982.

Three different forms of a nonlinear rainfall-runoff model are compared in one step ahead flow forecast under imbedded system and measurement noise distrubances. An iterated-extended Kalman filter algorithm is constructed with sequential linearization of the model for recurvise prediction of discrete conditional mean flows. The prediction algorithm includes process and measurement noise covariances which are estimated at observations through adaptation with the filter model residual. This approach aids in the proper sequential generation of estimation error co-variance for each state estimate. It is concluded that the dynamic system with flow and parameters as states provides an efficient flow forecast scheme.

061923
LORANT FI * **Keating Channel Flood Inquiry Report** * 8ip * 1981-07.

This report discusses the risk of flooding in Keating Channel, assesses the effectiveness of dredging in reducing floods, and proposes alternative flood mitigating measures. As no representative historial flow records were available for the Lower Don and Keating Channel area, data collected over the past 19 years at Todmorden were utilized in the study after correction to allow for urbanization. Three flood-vulnerable areas were identified in which overtopping of the banks is predicted for flows which can be expected to occur approximately once every 20 years. The risks associated with the floods are shown in a table. Plans have been prepared to carry out an Interim Dredging Program in the Keating Channel. The program would benefit the Keating Channel spill area, but for two upstream sites, additional flood mitigating measures would be needed. Until a permanent solution is found for the Keating Channel and the Lower Don Area, emergency measures are the first priority to consider in reducing future flood losses. While flood plain regulations are the most effective preventive measure, three corrective measures for the reduction or elimination of flood damages in existing developments are suggested.

066086
LORANT FI * **Truro hydrotechnical study: a tidal flood plain analysis** , IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * vi 289-306 * Can Soc Civ Eng * (1981).

The study, which forms part of the Canada-Nova Scotia Flood Damage Program, requires the identification of flood prone areas in the Salmon River and its tributaries. The community has been subjected in the past to a combination of events causing high water levels; such as the Bay of Fundy tides, which are the highest in the world, high freshwater floods, sea and river ice jams. The paper describes the combined effect of astronomical and meteorological factors on tides in the Bay and in the Salmon River Estuary. Historical data on high water levels in Truro are analyzed including conditions observed during Hurricane Beth in 1971. Design flow-frequency curves are presented for large water-sheds. For drainage areas under 25 sq km a design storm pattern is given for use in simulating design flows by computers. Frequency of flooding, based on historical records, is analyzed for conditions with and without ice jams. Computed and observed high water levels indicate that the existing dyking system cannot provide protection against the 100 year flood which is generally used in Canada as the flood plain criteria. Subsequent studies will be conducted to plot the 1 in 20 and 1 in 100 year flood plains.

063765
MACLOCK RB, PAGE GA * **Cutting our flood losses, Chapter 2** , IN: Water problems and policies * SEWELL WRD, BARKER ML * Cornett Occas Pap No 1 * 7-12 * Dep Geogr, Univ Victoria, Victoria, BC V8W 2Y2 * 1980.

This paper describes a federal flood damage reduction program introduced in 1975, designed to discourage unwise settlement in flood plains. Policies for reducing the potential for flood damage are contained in general agreements signed with each province and are followed by flood risk mapping agreements which provide a basis for designating areas where these policies will apply. Provision is also made for subsequent agreements on studies to reduce damages in developed flood plain areas and implementation of these measures. The flood risk map is the cornerstone of the Flood Damage Reduction Program. To guide hydrologists and standardize program procedures, the Inland Waters Directorate has prepared two publications with regard to flood plain delineation. One deals with survey and mapping procedures, and the other with hydrologic and hydraulic analysis. Under the program, the minister of Environment Canada

and his provincial counterparts may designate mapped flood risk areas and bring into effect policies for discouraging future developments that could be damaged by floods. Provisions are made for studies of existing problem areas. Where such studies have demonstrated they are needed, the best flood protection alternatives on the basis of cost, effectiveness, environmental impact and associated benefits could be implemented. The first studies being conducted under the Canada - Saskatchewan program are outlined.

062253
MARTZ L * **Whitemud River flood study** * 62p * Alberta Dep Environ, Environ Eng Support Serv, Tech Serv Div * 1980-02.
. This report is an evaluation of the flooding of agricultural land which occurs along the Whitemud River south of the Town of Dixonville, Alberta. The causes and extent of flooding is outlined and a number of alternative strategies for structural control of the flood problem are proposed.

061895
MCKELVIE SA * **Scarborough plays ball in Scarden Park stormwater facility** (see chapter 4.3 for complete reference - voir chapitre 4.3 pour la reference complete)

062871
NICHOLSON M * **Historical flood review of the town of Sackville** * 3p * 1982-08.
The Town of Sackville is located in southeastern New Brunswick west of the Tantramar River. Frosty Hollow Lake and Frosty Hollow Brook are located to the southeast of the town. Frosty Hollow Brook has frequently overflowed its banks, thereby creating flooding conditions within the town. The most serious flood events in Sackville occurred in 1759, 1869, and 1962. In 1759 and 1869 flood waters flowed over the dykes from the Tantramar River, while in 1962, flood conditions were the result of waters from Frosty Hollow Brook, which could not escape through the aboideaux. Dyke flooding has decreased during the past century, due to proper dyke maintenance. More common to a flood event in Sackville, are flood waters from Frosty Hollow, caused by heavy precipitation and snowmelt. When the tides are high, the run-off has no avenue of escape. In 1913, 1935 and 1953 and 1962, flooding associated with high tides took place.

062870
NICHOLSON ML * **Historical flood review of the Newcastle area** * 4p * 1982-06.
The most significant flood events in the Newcastle Area, in the past hundred years, are those of 1940 and 1970 which resulted in large flood damages. The annual peak stage usually occurs during spring runoff. However, flood stages associated with heavy precipitation between late May and early December, as was the case in 1940, may exceed the height of spring water levels. High water in the Newcastle area has never exceeded 1.2 metres above street level in the downtown area of Newcastle along the waterfront. Often inadequate drainage had aggravated flood conditions in this area. The worst flood event in the Town of Newcastle was in February of 1970. Business establishments sustained thousands of dollars in losses, several families had to be evacuated and roads were closed. However, the most severe damage in the Newcastle area was not comparable to the flood damage which took place along the upper reaches of the Miramichi River. Storm surges or storm tides along the seaward boundary of the estuary can be sustained by strong northeast winds of long duration at a time of changing atmospheric pressure. On these occasions, water levels along the estuary and particularly the outlying area such as Oak Point and Escuminac are raised and water damage occurs.

066979
O'DONNELL T * **Derivation of matched unit hydrograph and rainfall losses model for real-time flood forecasting** , IN: Decision making for hydrosystems: forcasting and operation. Int Symp on Real-Time Operation of Hydrosystems, Waterloo, Ont, 24-26 June 1981 * UNNY TE, MCBEAN EA * 405-413 * Water Resour Publ, PO Box 2841, Littleton, CO 80161 US * 1982.
After discussing the strengths and weaknesses of the unit hydrograph method, a strategy is set out for a conventional procedure for deriving sequentially a catchment average unit hydrograph followed by an associated rainfall losses model, both to be used subsequently for real-time flood forecasting. Problems approached with such a procedure are described. An unorthodox reversed unit hydrograph procedure is then proposed, one which simultaneously yields an average unit hydrograph and a rainfall losses model matched to each other. The general issue of relating a rainfall losses model to catchment wetness at the start of a storm is touched upon.

064804
PAGE GA * **The Canadian Flood Damage Reduction Program** * Disasters * 4(4) 411-421 * Pergamon Press Ltd * 1980.
Ad hoc investments in structural flood control measures and continuing high disaster assistance payments by both senior levels of government have often failed to reduce the damage sustained due to the floods in Canada. The national Flood Damage Reduction Program, undertaken by the federal government in conjunction with the provinces, has a new

comprehensive approach. This joint program emphasizes the non-structural means of reducing flood damages over the long term but also allows for structural measures where these offer the best solution for existing development in the flood plain. The historical and constitutional context, the rationale and details of the program and its success to date are outlined.

062444
PAUL AH * **The thunderstorm hazard on the Canadian Prairies** * Geoforum * 13(4) 275-288 * 1982.

An inital attempt is made here to assess the nature and magnitude of the thunderstorm hazard on the Canadian prairies. Past reserach into prairie thunderstorms has largely been conducted by meteorologists and has been marked by fragmented studies rather than overall synthesis. Canadian practitioners in the emerging field of natural hazards research have attached less importance to the prairie thunderstorm hazard and should stimualte critical thinking about responses and adjustments to it.

065755
PERKS AR, MOIN S, TAYLOR S * **Application of dynamic modeling to flood hazard mapping projects** , IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * v1 181-201 * Can Soc Civ Eng * (1983).

This paper describes the application of dynamic modeling techniques to the Canard River system in Southwestern Ontario. The river gradient is extremely flat, and extensive embayments and overbank storage areas exist in the lower reaches. The Dynamic Wave Operational Model (DWOPER) was applied for flood routing purposes. The model was developed by the U.S. National Weather Service to assist in flood forecasting, and has not been widely applied in Canada. DWOPER solves the complete dynamic wave equations for routing purposes, based upon input geometry and subarea hydrographs.

062089
PHINNEY RB * **Flood of June 1975 in the Oldman River Basin, Alberta** * 48p * Environ Can, Environ Conserv Serv, Inland Waters Dir, West North Reg, Calgary, Alta * 1982-10.

In June, 1975 a severe rain storm occurred over the upper portion of the Oldman River Basin in southwestern Alberta and northwestern Montana. During a four-day period, the storm deluged the area with up to 360 millimetres of rain. The storm resulted in flooding along the Oldman River and many of its tributaries. On some streams, the maximum flow for the entire period of record was observed. The flood had disastrous and tragic consequences. The flood was a contributing factor in the drowning death of one resident. Some livestock were lost as they were unable to escape the flood waters. Flood damage to the land and physical structures occurred throughout the basin, including the towns of Waterton, Pincher Creek, Fort Macleod and Cardston and the City of Lethbridge. Storm and flood forecasts by the federal and provincial governments provided some warning of the severe flooding and measures were taken to reduce the impact of the flood. This report contains a brief description of the Oldman River Basin, an analysis of the factors which caused the flood, and data showing the progression of the flood. A comparison is made between this flood and previous floods in the basin. The report also gives an outline of the forecasting and emergency measures which were performed prior to and during the flood. The report concludes with a summary of the flood damages.

065874
PRINCIC R * **Economic analysis of dyke improvement for Westham and Reifel Islands** * vp * Environ Can, Environ Conserv, Inland Waters Dir, Pac & Yukon Reg, Vancouver, BC * 1982-11.

The objective of this study is to examine the economic feasibility of upgrading the dykes of Westham and Reifel Islands to Fraser River Project standards to provide protection against a 200 year return flood. Economic feasibility is prepared for three dyke alternatives: one dyke incorporating both Westham and Reifel Islands; a dyke around Westham Island only; and a dyke around Reifel Island only. A modified method of estimating benefits using both tide elevations and probability of dyke failure was used in this report. The modified approach was to establish three failure modes, overtopping only, overtopping with a minor dyke breach and overtopping with a major dyke breach. The main advantage of this method over the standard procedure is that it allows a more realistic assessment of dyke failure for given tide levels. The standard procedure assumes the dyke has a 100% chance of failure once a specified tide level is reached, whereas this approach assigns probabilities of dyke failure for a range of tide levels. It is safe to conclude that the project, as it is presently conceived, would not yield positive net economic returns.

063279
PRINCIC R * **Economic analysis of dyke improvement for Westham and Reifel Islands** (see chapter 2 for complete reference - voir chapitre 2 pour la reference complete)

065752
PRINOS P, TOWNSEND RD * **Estimating discharge in compound open channels** . IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * 129-146 * Can Soc Civ Eng * (1983).

This paper presents the initial results of a theoretical and experimental study concerned with estimating the discharge of river channels in times of flood when interaction between flows in the main channel and those of the adjoining flood plain zones can significantly influence the stage-discharge relationship for the system. The laboratory study utilised a 12.2 m long prismatic channel having a variable width compound cross section comprising a trapezoidal-shaped main section flanked on either side by shallow berms (flood plains). Four different boundary roughnesses were used and system conveyance and boundary shear stress distribution, including apparent shear stress at the interface planes between main channel and flood plain zones, were monitored for a range of channel flows. Subsequent analyses of these data a produced statistical relationship between apparent shear stress tau sub a and other important parameters and a procedure for estimating discharge in compound channels was developed. Finally computed and observed data are compared and the advantages and limitations of the proposed method are discussed.

066107
RICHARD D, EL-JABI N, ROUSSELLE J, GIGNAC C * **Quantitative analysis of flood control projects in flood plains** . IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * v2 839-855 * Can Soc Civ Eng * (1981).

In the present study, relevant to water resources planning and management of river banks subject to flooding, technical, economic and physical considerations are integrated to yield a planning methodology for flooded areas. The fundamental objectives of such a methodology can be classified as follows: 1. analysing flood-damage transfer relations to obtain a probability distribution function of flood damage; 2. finding an estimate of this damage without having to make use of an after flood survey; 3. comparing the effectiveness of different flood-control measures. To reach the above objectives, digital simulation is employed. In this simulation the flood phenomenon along with its impact on flood plains are regarded as a complex system in which hydrologic features such as flood stage can be studied jointly with their economic impact on different sectors of economic activity. Richelieu river in the Province of Quebec is chosen for a numerical application of the final results. Its basin may be considered to possess both rural and urban characteristics.

063768
SIMMONS GE * **Approaches to flood control on the Fraser River, Chapter 5** , IN: Water problems and policies * SEWELL WRD, BARKER ML * Cornett Occas Pap No 1 * 35-45 * Dep Geogr, Univ Victoria, Victoria, BC V8W 2Y2 * 1980.

This paper describes recent approaches to flood control on the Fraser River. The extent of flooding problems in the Fraser River basin are described and major floods and their consequences are noted. Studies and boards that have dealt with the flooding problem are described and some of their recommendations are presented. Dyking programs that have taken place are described and flood warning and emergency procedures are discussed. This paper recognizes the potential of a serious flood hazard in the Fraser River Basin and indicates the remedial measures to minimize the effect, as a result of studies over the past 30 years. The main preventive measure is the system of dykes, but these must be supplemented with upstream storage. A flood warning system exists to allow for early introduction of emergency measures. A floodplain management program is also actively pursued to minimize flood damage within floodplain areas.

066088
SMITH DA, LOCKHART JG * **Development of the Saint John River flood forecast model** , IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * v1 327-351 * Can Soc Civ Eng * (1981).

The Government of Canada and the Province of New Brunswick entered into an Agreement Respecting Flood Forecasting in August, 1977. The Agreement provided for the development of a flood forecasting capability for the New Brunswick portion of the International Saint John River Basin. Activities under the Agreement have included the establishment and staffing of a flood forecast centre and the acquisition and installation of appropriate equipment; the undertaking of tasks required to design, develop, calibrate and test an effective flood forecasting system and the operation of the centre and information networks to provide the best possible forecasts of flooding. This paper describes the development of a flood forecast model for the Saint John River Basin. The basic component of the system is the U. S. Army Corps of Engineers' Streamflow Synthesis and Reservoir Regulation (SSARR) model. Other models employed are the Tennessee Valley Authority's Simulated Open Channel Hydraulics (SOCH) model and the National Weather Service's Dynamic Wave Operational (DWOPER) model.

063767
STAITE MJ * **Floodplain management: the Drumheller Valley, Alberta, Chapter 4** , IN: Water problems and policies * SEWELL WRD,

BARKER ML * Cornett Occas Pap No 1 * 25-34 * Dep Geogr, Univ Victoria, Victoria, BC V8W 2Y2 * 1980.

This paper discusses existing floodplain management policy, and potential land-use policy changes which could reduce the rate of floodplain development in the Drumheller Valley. A brief description is given of the Drumheller Valley and the flood history of the area is reviewed. Floodplain land-use is predominantly residential with settlements divided into three types: rural, City of Drumheller, and hamlets. Flood hazard adjustments are described including flood forecasting, emergency action, public relief and flood control. Floodplain land-use policy is discussed and alternative land-use policies are examined. Through Alberta Government programs, the Drumheller Valley is prepared for some emergency actions in the event of a flood. In order to reduce the rate of floodplain development, more precise definitions for the terms "flood prone" and "subject to flooding" need to be incorporated into development control bylaws and regional planning commission policies. Municipal governments should consider implementing a two-zone floodplain district, to be legally defined in the municipal development control bylaws.

066074
VEALE BJ, MITCHELL B * **Floodplain policy and practice in the Credit River watershed, Ontario** * Can Water Resour J * 8(3) 39-57 * 1983.

Analysis of floodplain policy and practice in the Credit River watershed in Ontario revealed that although there has been an increase in the use of non-structural adjustments, municipalities and residents favour structural adjustments to reduce flood hazard at the community level. Several factors contribute to discourage widespread acceptance and adoption of non-structural adjustments. First, available financial arrangements provide an incentive for water managers to select structural solutions rather than non-structural adjustments. Second, enforcement of non-structural floodplain management alternatives is difficult. Third, communication problems among residents and resource agencies often undermine adjustments, such as flood warning systems. Fourth, jurisdictional fragmentation among resource agencies results in overlapping responsibilities and duplication of management activities which mitigate against a systematic and integrated approach to reducing urban flood problems and allows agencies to evade their responsibilities. These findings support results from an earlier study of floodplain policy and practice in the Grand River watershed in Ontario, and suggest that similar trends may predominate in other Ontario watersheds.

065766
WARNOCK RG * **Unsteady flow in pavement drainage design** (see chapter 4.3 for complete reference - voir chapitre 4.3 pour la reference complete)

066968
WATT WE, NOZDRYN-PLOTNICKI MJ * **Real-time flood forecasting for flood damage reduction** , IN: Decision making for hydrosystems: forecasting and operation, Int Symp on Real-Time Operation of Hydrosystems, Waterloo, Ont 24-26 June 1981 * UNNY TE, MCBEAN EA * 551-571 * Water Resour Publ, PO Box 2841, Littleton, CO 80161 US * 1982.

Queen's University Forecasting Method (QUFM) is a general forecasting method which is relatively inexpensive to set up and operate. It incorporates both deterministic and stochastic components. The three submodels comprising QUFM are a snowmelt model, a loss model and a transfer function-noise model. A case study is presented in which QUFM and NWSRFS (Stanford version) are used to formulate flow forecasts on one, two and three days lead time. Analysis of the forecasting results indicates that the forecasting accuracies of the two models are comparable. Since QUFM is easier to set up and operate it presents an attractive alternative to such a model as the NWSRFS (Stanford version).

066531
WAYLEN P, WOO MK * **Annual floods in southwestern British Columbia, Canada** * J Hydrol * v62 95-105 * 1983.

In southwestern British Columbia there exists a transition from rain-generated floods in the west to snowmelt floods in the east. When a single process dominates, the Gumbel distribution provides an adequate fit to observed flood exceedance probabilities. The two processes produce distinct timing and magnitude characterisations in the resultant floods. The area of transition between these two sets of conditions displays varying mixtures of both characteristics which can best be fitted by a compounded Gumbel distribution. It is proposed that this technique is generally applicable wherever annual flood series are generated by more than one hydrological process.

063626
WAYLEN PR, WOO MK * **Stochastic analysis of high flows in some Central British Columbia rivers** * Can J Civ Eng * 10(2) 205-213 * 1983-06.

High flows derived from the partial duration series were analysed in terms of the probability distributions of magnitude, frequency, duration, and the time of occurrence. Simple methods of representing the timing and duration of high flows as

stochastic variables are presented. Existing stochastic models are applied to the probability distributions of the annual frequency of high flows and their magnitudes. A consideration of the statistical properties of the above stochastic variables leads to the development of a technique with which floods exceeding any higher level of interest may be investigated without resorting to a reanalysis of the historical data. The proposed methodology was applied to the daily streamflow records of three rivers located in diverse hydrological environments in Central British Columbia. Good agreement between the computed and the observed data in all cases reflects the applicability of the technique.

062270
WIGLE R, LONGLAND M, MCBEAN EA * **Exploration of response alternatives for real-time flood forecasting** . IN: Int Symp on Real-time Operation of Hydrosystems, June 24-26, 1981, Univ Waterloo, Waterloo, Ont, Proc, Vol I * UNNY TE, MCBEAN EA * 53-70 * Univ Waterloo, Waterloo, Ont * (1981).

The operational characteristics of the multi-reservoir Sturgeon River/Lake Nipissing/French River system are examined to determine improvements obtainable from flood forecasting capabilities. Improved water level control opportunities are provided and the abilities of the HEC-5 model in this type of model application are discussed.

4.3 Urban Hydrology - Hydrologie urbaine

065783
ASHAMALLA A, MUMFORD D * **Application of stormwater management to arid regions, a case study** . IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * v2 739-757 * Can Soc Civ Eng * (1983).

This paper examines some aspects related to the management of stormwater runoff from urban communities in arid regions. Several considerations related to storm drainage are discussed. A case study is presented which deals with the application of the EPA - Stormwater Management Model (SWMM) for the design of extensive storm drainage systems. The study area is approximately 5450 ha and covers the currently serviced areas and proposed urban development in and around the City of Al Hassa, Kingdom of Saudi Arabia. The project includes the final design of the proposed drainage services for 1800 ha development. The estimated capital cost of the storm drainage system for this area is $132 million which includes 85 km of sewer length and four pumping stations.

065596
BARNWELL TO, JAMES W (ED) * **Proceedings Stormwater Management Model (SWMM) Users group meeting, January 19-20, 1981** * 257p * McMaster Univ * 1981.

This report includes nine papers on topics related to the development and application of computer-based mathematical models for water quantity and quality management presented at the semi-annual meeting of the Joint U.S.-Canadian Stormwater Management Model (SWMM) Users Group held 19-20 January 1981 in Austin, Texas. Topics covered include descriptions of the National Urban Runoff Program Study and a corollary study of metals fate in the Austin, TX area; three papers discussing a study of combined sewer overflows in the Detroit area and their impacts in the Rouge and Detroit rivers; three papers describing stormwater modeling in the Hamilton, Ontario area; and a paper describing the use of SWMM/RECEIV hydrodynamic simulation with Dynamic Estuary Model water quality algorithms. A discussion of an earlier paper on an application of the TR-55 model and a reply by the author are included.

F11957
BERON P, BRIERE F, ROUSSELLE J, RILEY JP * **Etude du controle en temps reel d'un intercepteur unitaire** . IN: Compte rendu, Colloque sur la modelisation des eaux pluviales, tenu au Holiday Inn Centre-Ville, Montreal, Que, 8-9 sept, 1983 * BERON P, BARNWELL T * Rapp GREMU 83/03 * 112-127 * Ec Polytechnique Montreal & US Environ Prot Agency * 1983-10.

Cet article presente les resultats obtenus lors d'une etude sur l'efficacite relative de divers modes de controle en temps reel des deversements de reseaux unitaires en temps d'orage. Cinq modes de controle, allant du tres simple au tres sophistique, ont ete compares en utilisant un cas hypothetique. Deux types d'intercepteur ont ete consideres, l'un de conception classique, l'autre d'une capacite d'emmagasinement plus grande. La comparaison de l'efficacite des modes de controle est effectuee a l'aide d'une mesure de l'impact des deversements sur la qualite de l'eau de la riviere, impact evalue a partir des variations d'un indice de qualite de l'eau. Les resultats obtenus montrent qu'un mode de controle tres sophistique n'est pas necessairement plus efficace qu'un mode de controle beaucoup plus simple.

065114
DICKISON RBB, DAUGHARTY DA * **The effects of snowmelt runoff of the removal of forest cover** (see chapter 8 for complete reference - voir chapitre 8 pour la reference complete)

063524
ELLIS H, MULAMOOTTIL G, MCBEAN E * **Zero side yard housing, acceptance and stormwater management implications** * Can Water Resour J * 8(2) 19-31 * Can Water Resour Assoc, PO Box 250, Kingston, Ont K7L 4V8 * 1983.

The trend in the housing market over the next few years is expected to reflect increased demand in medium-density housing. One of the modern versions of the traditional single-family unit that can be included in medium-density housing is the zero side yard or zero lot line unit. Public acceptance, thus far, of zero side yard housing is discussed. Of primary concern in this paper are the potential stormwater management implications associated with zero lot line as opposed to more or less conventional subdivision designs. Using hypothetical test scenarios, stormwater quantity and quality runoff regimes were generated using the U.S. EPA SWM model. Results indicate that the increased runoff quantity and decreased water quality associated with zero lot line developments over that of conventional subdivisions can be significant. Of practical interest are the ramifications of these results with respect to the design of stormwater management facilities.

F11958
GALAND JL, BRIERE F, ROUSSELLE J, BERON P * **Relation qualite-debit dans un reseau unitaire** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

065754
GOULTER IC, KIELY DA * **Changes in flood level differences with urbanization - a predictive study** - (see chapter 4.2 for complete reference - voir chapitre 4.2 pour la reference complete)

066375
HOFFMAN EJ, MILLS GL, LATIMER JS, QUINN JG * **Annual input of petroleum hydrocarbons to the coastal environment via urban runoff** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

062507
JAMES W * **Introduction to stormwater modelling** , IN: Canadian Society for Civil Engineering, Ont Reg, Conf Proc, Application of Hydraulics in Municipal Engineering, April 24, 1981, Windsor, Ont * 1-50 * (1981).

Stormwater modelling is described focusing on an understanding of the physical processes involved in the study problem and a careful evaluation of reasonable alternative designs. Activities involved in a stormwater modelling study are described in detail: problem review; listing of study objectives; selection of model performance criteria; specification of requisite accuracy; review of available data and study resources; computer program selection criteria; model verification; model calibration; model validation; establishment of minimum level of system discretization; sensitivity analysis; input data preparation and output interpretation; documentation of thermodified program actually used; and, preparation of machine readable input and output files for archiving. Advantages of using a program such as SWMM (Stormwater Management Modelling), capable of describing urban hydrology and drainage hydraulics to a high level of system detail and of providing a thorough evaluation of reasonable alternative designs for complex systems, are described.

065594
JAMES W * **Computer modelling of Hamilton's urban drainage system** , IN: Pollution Control Conf, Nov 14-15, 1980, Hamilton, Ont * 1980.

A joint study on the 120 square kilometer urban drainage system in the city of Hamilton by McMaster University and the Hamilton-Wentworth Regional Engineering Department was recently implemented. The Ontario Ministry of the Environment is also participating in part of the study. The quantity and quality of stormwater runoff, combined sewer overflows and dry weather flow into Cootes Paradise and Hamilton Harbour have been modelled. Various strategies for minimizing pollutant loadings into these receiving waters are being formulated and compared. The drainage system comprises 3 major drainage basins, with 15 combined sewer outfalls (greater than 1.22 m diameter) and 290 known active diversion structures. The drainage basins are aligned along prevailing storm tracks. Pollutant loads to the receiving waters appear to be sensitive to the causative storm motion and dynamics and consequently an accurate description of storm rainfall is required. Ten rainfall-intensity monitoring stations recording at a resolution of one minute in conjunction with 7 streamflow monitoring and water quality sampling stations provide a large base of synchronized data: rainfall intensity, rainfall direction, rainfall quality, flowrates, suspended soilds, BOD5, total phosphorous and total nitrogen. Water quality analysis is being carried out by the MOE. The paper includes a brief description of the drainage system, the field equipment and the Stormwater Management Model (SWMM) for the study area. The paper also describes the data acquisition system and the programs used to develop a management strategy for minimizing pollutant loadings to the receiving waters from the combined sewer and drainage system.

065589
JAMES W * **Hamilton stormwater modelling study, report no. 2: 1980 summer field programme** * CHI Publ R71 * vp * Civ Eng Dep, McMaster

Univ, Hamilton, Ont * 1981-03.

Beginning in early summer 1980, a network of streamflow and rain gauges was established in the City of Hamilton to provide the following information for all significant storms: (a) spatial and temporal distributions of rain (b) runoff quantity (stormwater and combined sewer overflows) (c) runoff quality (stormwater and combined sewer overflows) The data will be used to calibrate storm water management models, including SWMM, for the Hamilton urban drainage system. The precipitation measurements provide information on thunderstorm kinematics in the City, which is complicated by a valley and escarpment. Three major drainage basins have been identified within the city limits: Chedoke Creek, Redhill Creek and the Central Business District. Five out of seven planned streamflow gauges have been installed within these basins. Water quality samples have been collected at each streamflow gauging site for each major storm in the period June - August. The criterion for initiating sampling is that the rainfall intensity must exceed 0.25 in. (6.35mm) accumulation. Water quality samples were analyzed at the Ministry of the Environment laboratories for: suspended solids, BOD5, total-N, and total-P. This report describes the installation and calibration of the field equipment and summarizes all procedures for acquiring and analyzing the data. All data collected is presented on a storm basis in the appendices to the report.

062503

JAMES W, DRAKE JJ * **Kinematic design storms incorporating spatial and time averaging** , IN: Proc Stormwater Management Model (SWMM) Users Group Meeting, June 19-20, 1980 * EPA-60019-80-064 * 133-149 * US Environ Prot Agency, Environ Res Lab, Athens, GA US * 1980-12.

The paper explores the use of a numerical storm model as a pre-processor for a detailed urban runoff model. The proposed storm model generates hyetographs for each subcatchment, thus simulating the spatial and temporal growth and decay of a system of storm cells as they move across an urban catchment system. Traditionally, design storms were and continue to be developed from statistical analysis of point rainfall records that include all types of rainstorms; the methodology was originally appropriate for flood predictions based on the rational formula. The resultant rain distributions are unlike any type of observed rain storm. This synthetic temporal distribution is typically applied uniformly across the catchment and flow hydrographs are consequently also unlike observed runoff hydrographs. Large static cells of uniform rainfall intensity are rare even in prolonged frontal events. Convective cells tend to be circular with a circular rainfall intensity pattern. Rain cells tend to be elliptical, aligned sub parallel to it. Rainfall is typically most intense near the leading edge of the cell. Fast moving storms produce very rapid point-intensity-duration changes. Statistics of the size and distribution of rain cells can be obtained most readily from weather radar studies. The storm model presented in this study is based on the synoptic observations of rain cells reported in weather radar studies. The storm model presented in this study is based on the synoptic observations of rain cells reported in weather radar literature. Intensity-duration-frequency curves obtained from the model are similar to those derived statistically from the long-term rainfall record. The model is applied to catchments in the Hamilton area in Southern Ontario. Results indicate that storm cell kinematics are significant, particularly in peak runoff estimates (for drainage design) and water pollutant loading estimates, because of the sensitivity of the time-to-peak and rate-of-rise of hydrographs and pollutographs. Such storm models appear to be useful for computer-based rainfall-runoff studies.

065591

JAMES W, HARO H, ROBINSON MA, HENRY D, KITAI R * **Hydrometeorological data acquisition: innovative, high-resolution programmable instrumentation for stormwater management** , IN: Proc of Stormwater and Water Quality Management Modeling Users Group Meeting, 25-26 March 1982 * 128-151 * US Environ Prot Agency, Environ Res Lab, Athens, GA * 1982.

The paper describes difficulties with existing instrumentation, a new raingauge for sensing rainfall intensity at a high time resolution, and associated new instrumentation. The data logger incorporates an audio cassette unit for data retrieval and a single chip microcomputer programmed to record appropriate time series data in compact form. The data on the retrieved cassettes is input and stored on removable hard-disc packs via a PDP 1123 microcomputer through a specially devised decoder, also incorporating a single chip microcomputer. Special interactive FORTRAN applications software on the 1123 processes the time series data files and plots hyetographs on a desk-top plotter. Sample input/output is provided. The entire system is designed to be inexpensive, using cheap, mass-produced components. The system is being extended to monitor water depth (discharges), temperature, conductivity and pH. The system is designed for use in real-time control.

065595

JAMES W, HENRY D * **Development of a stormwater overflow model for pollutional loadings to Hamilton's receiving waters, summer field program and data for period May to October 1981** * CHI Publ R86 * vp * Civ Eng Dep,

McMaster Univ, Hamilton, Ont * 1982-03.

The 1981 Summer Report describes the installation and calibration of all the field instruments and equipment. The report summarizes all procedures for collecting and analyzing field data. All data collected is presented on a storm basis in the Appendix. The field programme used eleven hydrometeorological sites throughout Hamilton. Unfortunately only three of these stations sampled flow. These sites were located in the Chedoke Creek. Two flow measuring stations located in the Redhill Creek were inoperable due to vandalism and recording malfunctions. Only limited water quality sampling was accomplished during the summer because the major storm events occurred between 00:00-04:00 hours. Water quality data is not presented in this report.

062856

JAMES W, HENRY D, HARO H * **Integrity of rainfall time series for models of existing combined sewer systems** . IN: Proc of Stormwater and Water Quality Management Modeling Users Group Meeting, 18-19 October, 1982 * WISNER PE * 146-159 * IMPSWM, Univ Ottawa, Dep Civ Eng, Ottawa, Ont K1N 9B4 * 1983-04.

Current stormwater management modelling practices appear to lag behind recent conceptual advances, both in hydrometeorological ideas and engineering design software. Rainfall inputs being used are simply out of date; usage bears little relation to newly available field instrumentation, concepts of storm dynamics and the evolving computational environment. The development of current practice is briefly reviewed. New developments in field data acquisition, synoptic processing of point rain data, dynamical storm modelling and continuous stormwater management modelling are introduced. These developments are rendering design storm methods obsolete. One-minute rain data acquired from a dense network of synchronized gauges are compared with results obtained from a duplicate network of standard tipping bucket rain gauges for a typical storm. The respective records are integrated and comparative results given. Instantaneous rainfall rates may be an order of magnitude greater than rain used in the continuous models. An uncalibrated, discretized catchment area in the City of Hamilton is modelled using SWMM and actual precipitation data. Both the rain data and the hydrology are resolved to 1, 5, 15, 30 and 60 minute time steps. The modelled and observed results are compared. The errors inherent in continuous models appear to be of the order of 300% for this catchment and storm. Water modelling based on design storms derived from simplistic analysis of point rain data produces hydrographs of indeterminate return period. There appears to be little justification for continuation of this methodology.

065598

JAMES W, MITRI H * **SWMM compatible algorithm for side-weir structures** . IN: Proc Stormwater Management Model (SWMM) Users group meeting, Jan 19-20, 1981, Austin TX * 141-157 * McMaster Univ * 1981.

Combined sewer systems are designed to bypass significant flows directly to the receiving water during rainstorm events. Thus to estimate pollutant loadings to the recipient water it is necessary to estimate or compute continuous hydrographs and pollutographs for the full period of potential overflows to the recipient waters. Since a diversion structure is active only during a storm event, and diverts only part of the hydrograph, a rating curve for the diversion structure must be obtained. Few structures have been adequately calibrated and rating curves for such devices are usually unavailable. Overflow and diversion structures may be classified according to the shape of the sill or overflow control, eg. end weirs, oblique weirs and side spillways. Many structures experience hydraulic jumps of complex planforms over much of the operating range. The paper reviews the hydraulics of side spillways and SWMM-EXTRAN. A new program called OVRFL03 has been developed to dovetail externally with the SWMM package. As a stand-alone program, it will produce rating curves for side-weir diversion structures. The program is being applied to urban catchments in the City of Hamilton. Verification tests were carried out and results are presented and discussed in the paper.

062498

JAMES W, ROBINSON M * **Co-ordinated multiprocessing for large scale data acquisition and simulation of urban drainage for the Hamilton-Wentworth region** . IN: Canadian Society for Civil Engineering, 5th Can Hydrotechnical Conf, May 26-27, 1979, Fredericton, NB * 801-815 * (1981).

The quantity and quality of stormwater runoff, combined sewer overflows and dry weather flow to the receiving waters of Coote's Paradise and the Hamilton Harbour, from the 120 square kilometer urban drainage system in the City of Hamilton, have been modelled. Various strategies for minimizing pollutant loadings to these receiving waters will also be studied. The drainage system comprises 3 major drainage systems, with 15 combined sewer outfalls greater than 1.22 m diameter and many known active diversion structures. Five rainfall stations and five streamflow and water quality sampling stations provide data on rainfall intensity, storm direction, storm speed, flowrate, suspended solids, BOD5, total phosphorous and total nitrogen. A minicomputer executes FORTRAN pre- and post-processor programs for a package of stormwater management models residing and executing on remote mainframes. The paper includes a brief description of the pre- and

post-processors, sensitivity analyses and calibration of the RUNOFF quantity and quality block of the Stormwater Management Model (SWMM) for the study area. A method is proposed by which a data acquisition network, based on microprocessors and transmitting via acoustic line to a central minicomputer can be used to develop and implement a real-time control system for minimizing pollutant loadings to the receiving waters.

065590
JAMES W, ROBINSON M * **Continuous models essential for detention design** * 1-13 * 1982.

Traditional design methodology for stormwater detention ponds is based on primitive methods such as design storms derived from intensity-duration-frequency analysis. Some of these methods have been enhanced in recent years and discrete-event hydrograph routing is typical. Modern design requires better estimates of initial conditions in the pond and the contributing catchment. This indicates a need for continuous modelling. The paper describes techniques to account for general characteristics of real summer thunderstorms which, if ignored, lead to substantial errors. Difficulties associated with continuous modelling include smoothing due to coarse time-steps, input data deficiencies, and the management of large amounts of output data. Calibration of our continuous models requires inexpensive field instrumentation, specifically designed for use with continuous models running on micro-computers.

062504
JAMES W, ROBINSON MA * **Terms of reference common to computer-based stormwater studies** , IN: Proc Canadian Society for Civil Engineering Annual Conf, May 29-30, 1980, Winnipeg, Man * 1-16 * (1980).

The main purposes of modelling are a reasonable understanding of the physical processes involved and a careful evaluation of reasonable alternative designs. The central concern is credibility. Increasingly, government and municipal engineers supervise studies in which sophisticated computer models are being used by specialists. Because of the large variety of programs available, the rapid evolution of the models and because of their complex structures, the studies are becoming increasingly difficult to manage. In the initial study terms of reference, the following component study activities could be specified in detail when bids are requested: problem review, study objectives, performance criteria, requisite accuracy, review of available programs, available data and study resources, program selection criteria, model verification, model calibration, model validation, minimum level of discretization, sensitivity analysis, data preparation and output interpretation, documentation of the modified program actually used, and preparation of machine readable input and output files for archiving. Many of these activities will be carried out by a reputable engineer in any case. Each of these points is discussed in general terms but the examples used are appropriate to stormwater management modelling studies particularly the hydrological portion of the Stormwater Management Model. By including these terms of reference, all consultants bidding will be assured that their costs will be met, and clients will be insuring their investment in design engineering with a modest premium.

065781
JAMES W, SHIVALINGAIAH B * **Stormwater quality and atmospheric pollution modelling in an industrial city** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

065782
LORANT FI * **Erosion control by storm water management - is it worth a dam?** (see chapter 7.2 for complete reference - voir chapitre 7.2 pour la reference complete)

065793
MARSALEK J, WATT WE * **Design storms for urban drainage design** , IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * v2 953-978 * Can Soc Civ Eng * (1983).

The design storm concept is well established in Canadian urban drainage practice, although some confusion results from an incomplete definition of design storms and their applications. To remedy this situation, it is recommended that design storms be developed for a wide range of return periods; these storms should be based on local AES rainfall data, given for both the rational method and hydrograph model applications, and supplemented by specifications of the computational procedure and normal antecedent conditions. The design storms hyetograph would be defined for a particular region, return period and catchment time constant and, when applied in conjunction with the specified computational procedure and antecedent conditions, would produce a peak flow of approximately the same return period as that of the design storm. None of the existing design storms has all these features but further work on temporal distributions and antecedent conditions would result in an acceptable set of design storms.

065791
MATHER JC * **Relationship between stormwater management and watershed management** , IN: Canadian Society for Civil Engineering, 6th

Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * v2 933-941 * Can Soc Civ Eng * (1983).

After hundreds of years of concurrent and parallel development, the fields of municipal engineering and flood control engineering are finally on convergent paths which will have a very pronounced and beneficial impact in the area of watershed management. The force which has precipated this change in direction has been the development of the relatively new field of Storm Water Management. The tool that will be used to achieve his union, was developed as the first step in Storm Water Management and is known as the "Master Drainage Plan". The relationship or link between watershed management and storm water management is really embodied in the "Master Drainage Plan". Although still in its infancy the application of good storm water management based on a well developed "Master Drainage Plan" will redirect and re-emphasize the traditional approaches to watershed management.

061895
MCKELVIE SA * **Scarborough plays ball in Scarden Park stormwater facility** * Civic * 34(10) 20-22 * Maclean Hunter Ltd, 481 University Ave, Toronto, Ont M5W 1A7 * 1982-10.

Scarden Park in Scarborough, Metropolitan Toronto, is a multi-use stormwater detention facility which gives both flood protection and recreational facilities. The flood control scheme developed utilizes park areas and a hydro right-of-way for the construction of 5 major detention facilities. To date, the Borough has constructed 3 open stormwater detention facilities as well as 3 underground facilities and associated sewers. Because of the land configuration and the layout of the existing storm sewer system, the consulting engineers had to incorporate many hydraulic features into the design of the Scarden Park facility. Safety aspects of the design include gentle side slopes, a lag time before filling begins, low outflow velocities, carefully controlled drainage velocities, night lighting, and a remote water level monitor which warns staff if water is being stored in the park. Recreational activities include a jogging trail, play areas, toboggan hill, and a softball diamond with an amphitheatre. Public participation resulted in a cooperative attitude, which was a major factor in the success of this project.

065794
NOVAK Z, WHITEHEAD BA * **Urban stormwater quality, Devon pilot catchment, City of Stratford** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

065599
ROBINSON M, JAMES W * **Co-ordinated multiprocessing for real-time control of urban drainage** , IN: Proc Stormwater Management Model (SWMM) Users group meeting, Jan 19-20, 1981, Austin, TX * 119-140 * McMaster Univ * 1981.

A modelling study is currently being undertaken to evaluate the quantity and quality of stormwater runoff, combined sewer overflows and dry weather flow from the 120 square kilometer Hamilton urban drainage system. Various strategies for minimizing pollutant loadings to the receiving waters are being studied. The drainage system comprises 3 major drainage basins, with 15 combined sewer outfalls (greater than 1.22 m diameter) and a large number of known active diversion structures. Five rainfall-intensity stations and five streamflow and water quality sampling stations provide a large data base: rainfall intensity, storm speed and direction, flowrate, suspended solids, BOD5, total phosphorous and total nitrogen. Rainfall in the urban area varied spatially significantly in both intensity and volume. Streamflow and pollutant loadings were found to be sensitive to synchronization errors. A mamimum temporal resolution of 5 minutes is required to limit potential errors to less than 10%. The drainage basins are aligned along prevailing storm tracks. Pollutant loads to the receiving waters appear to be sensitive to storm motion. An accurate description of storm rainfall is essential. The paper includes sensitivity analyses and proposes a synchronized data acquisition network for real-time control.

062505
ROBINSON M, JAMES W * **Simulation of urban drainage for Hamilton using co-ordinated multi-processing** , IN: Second International Conf on Urban Storm Drainage, Urbana, IL, US, June 14-19, 1981 * 398-405 * (1981).

A joint study by McMaster University, the Hamilton-Wentworth Regional Engineering Department and the Ontario Ministry of the Environment is currently being undertaken to model the quantity and quality of stormwater runoff, combined sewer overflows and dry weather flow to the receiving waters from the Hamilton urban drainage system. The system comprises 3 major drainage basins. Five rainfall monitoring stations and five streamflow monitoring and water quality sampling stations provide a large data base: rainfall intensity, storm speed, storm direction, flowrate, suspended solids, BOD5, total phosphorous and total nitrogen. The rainfall occurring in the urban area was observed to differ significantly in both intensity and volume from that observed at gauges in the surrounding area. The drainage basins are aligned along prevailing storm tracks. Pollutant loads to be receiving waters appear to be sensitive to causative storm motion and dynamics and consequently an

accurate description of storm rainfall is required. Streamflow and pollutant loadings were also found to be sensitive to synchronization errors in recorder timing. A maximum temporal resolution, for the data being collected, of 5 minutes was required to limit potential errors in total loading within 10%. A method is proposed using a synchronized data acquisition network, based on microprocessors and transmitting via acoustic line to a central minicomputer, to develop and implement a real-time control system for a combined sewer and drainage system.

065588
ROBINSON MA, JAMES W * **Continuous SWMM modelling of summer stormwater runoff quality in Hamilton, preliminary output time series analysis** * Chi Publ R85 * 284p * Civ Eng Dep, McMaster Univ, Hamilton, Ont * 1982-01.

This report summarizes the development of a continuous water quantity and quality model of Hamilton's summer urban stormwater drainage system. The model simulates continuous loadings at major combined sewer overflow outfalls to Hamilton Harbour. Parameters for the SWMM model of the system, developed during calibration and validation, are summarized. Machine readable data files have been created and are archived for future reference. Estimates of total loadings of non-point source pollutants are summarized and discussed together with the results of statistical analyses performed on these estimates. A methodology is proposed whereby statistically-based equations can be used to estimate pollutant loadings to the Hamilton receiving waters on a long-term basis for coarse time-steps.

065757
ROWNEY AC, CHEUNG PW, LOIJENS HS, PERKS AR * **Evaluation of fecal coliform bacteria sources in an urban stream** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

065792
RUSSELL SOD * **Urban drainage problems** , IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * v2 943-951 * Can Soc Civ Eng * (1983).

Although designers of urban drainage systems have to deal with many complexities and uncertainties, in practical situations there are often key features which have a dominant influence on the design. Examples of urban drainage design problems from the Vancouver area are presented to illustrate the importance of such local conditions. Suggestions are offered for urban drainage design in the light of experience gained from these examples.

063527
SCOTT WS * **Factors influencing the behaviour of de-icing salts in an urban flood control reservoir** * Can Water Resour J * 8(2) 104-120 * Can Water Resour Assoc, PO Box 250, Kingston, Ont K7L 4V8 * 1983.

Water samples collected from a newly constructed reservoir and its watershed during a complete salting season indicated the presence of high concentrations of chloride and sodium in the bottom waters of the reservoir at the beginning of thaw periods. This effect occurred despite the face that water flowing out of the reservoir is normally drawn from very near the bottom. The salt-laden bottom waters were eventually drained from the reservoir as the thaw periods continued, or after freezing temperatures returned. Elevated salt levels returned, however, at the beginning of each successive thaw period. The number and duration of thaw periods and associated rainfall were found to be major influences on the accumulation and behaviour of the salt-laden waters. Factors influencing salt levels in the source streams were analyzed. Salt inputs were shown to be significantly correlated with: the amount of salt applied to streets prior to thaw periods, the degree of urbanization of the watershed, length and type of roads drained, the duration of thaw periods, precipitation, and the rate of rise in temperature at the start of thaw periods.

065593
SHIVALINGAIAH B * **Background review atmospheric fallout and stormwater quality in Hamilton** * vp * 1982-01.

Atmospheric fallout has been identified as one of the main pollutant contributing sources to surface runoff. A background review on atmospheric fallout and stormwater quality in Hamilton is the essence of this report. Since 1947, atmospheric fallout studies have been in progress. Portions of the lower city and the beach strip near the industrial area lie within the 9.0 gram/sq.m.-30 days dust isopleth which is twice the MOE objective. Most of the remaining area is included in the 4.5 gram/sq.m.-30 days dust isopleth. Funnelling of westerly winds because of the Niagara escarpment and Dundas Valley is common over Hamilton. Lake breezes cause a build up of pollutant in the atmosphere. Atmospheric pollutants contribute significant quantities of dust and nutrients to surface runoff.

065592
SHIVALINGAIAH B, WILLIAM J * **Atmospheric pollution in relation to storm water quality modelling: literature review for an industrial city** , IN: Proc of Stormwater and Water Quality Management Modeling Users Group Meeting, 25-26 March 1982 * 274-295 * US Environ Prot Agency, Environ Res Lab, Athens GA * 1982-08.

The atmosphere is one of the largest sources of pollutants in surface runoff in an industrial city. The location of the major industrial areas, wind direction and velocity and source concentrations are important parameters in the prediction of the atmospheric fallout component of surface loadings. Isopleths of atmospheric fallout are correlated with these parameters and superimposed on the discretized catchment. The total accumulated dry weather loading is input to the water quality sections of SWMM-RUNOFF. The water quality algorithms in SWMM III are reviewed and improvements suggested, eg. inclusion of atmospheric fallout and scavenging, street sweeping time series data, separation of pollutant source areas, variable time step hydrology and moving storm analysis.

061983
SINGER SN * **Evaluation of impacts of storm water runoff and combined sewer overflows on receiving waters, an assessment procedure** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

067084
SMITH AA, FALCONE JP * **MIDUSS - a design program for storm water sewerage** , IN: Can Soc Civ Eng 1983 Annual Conf, Proc, Recent Developments in Computer Applications in Civil Engineering, June 1-3, Ottawa, Ont * 173-190 * Can Soc Civ Eng, Comp Appl Div * (1983).

Many programs used for storm water management are intended primarily for analysis or simulation. This paper describes a program which facilitates the design of conveyance or detention storage elements in a tree network. The program is command driven and allows the design to proceed in a manner similar to traditional methods (e.g. the rational method) by allowing the user to define individual sub-catchments to generate the overland flow. The resulting hydrographs may be examined, stored, accumulated or routed to allow the synthesis of the drainage network by the design of pipe and pond elements. The user may experiment with alternative trial designs until satisfied with the outcome. As the design proceeds, a file is updated which records the data input and the final design decisions made. This file may be used in subsequent design sessions during which the user may switch from manual (i.e. keyboard) to automatic (i.e. file) input. This allows continuation of a previous design session, testing of a prior design with a different storm, or re-design of specific elements of the system. An important feature of design packages of this type is the ability of the user to monitor progress at each step and take corrective action in the event of bad data or incorrect design decisions.

061894
STINSON SA * **Running storage method of storm water management** * Civic * 34(10) 12, 14 * Maclean Hunter Ltd, Toronto, Ont M5W 1A7 * 1982-10.

In stormwater management, increased storage of rainfall is needed until the peak of the runoff curve has passed. Static permanently flooded ponds and temporary ponds are alternative methods. Another method, developed for 2 London, Ontario subdivisions, is "running storage", a practical solution for controlling peak runoff when soil conditions or lack of land make permanent static ponds unsuitable. The challenge was to develop an open channel with sufficient capacity to pass all Regional Storm flows without increasing peak flows at the downstream discharge point. The solution was to use the storage capacity inherent in a large, slowly moving channel. For drop structures over 2 m, vertical side walls are essential, but for lower vertical drops, less than 0.9 m, sloping sides and trapezoidal cross-sections work well. Low cost drop structures using light weight steel sheet piling are acceptable, and the invert will be paved with interlocking paving stones above and below the drop structures for erosion protection. Running storage is a cost-efficient method of controlling peak storm water runoff in the appropriate circumstances.

066106
VATAGODAKUMBURA S, FOK ATK * **A review of methodologies and techniques of urban hydrologic analysis** , IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * v2 817-837 * Can Soc Civ Eng * (1981).

The goals of urban drainage and flood control projects have progressed to a level where design of major and minor conveyance systems, runoff control measures have to be concurrently considered. In view of the resulting complexity of design, function, and maintenance, engineering evaluation can no longer be left at purely empirical levels. Current methods of analysis make use of computer oriented mathematical models capable of simulating the urban hydrologic process. This paper reviews the application of currently available hydrologic models, such as SWMM, STORM and HYMO and some of the necessary hydrologic characteristics. A review of some recent Municipal Drainage Manuals and future trends are also presented.

065795
WALLER DH, HART WC, THIRUMURTHI D * **Halifax Urban Watersheds Program - a case study in urban stormwater quality management** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

065766
WARNOCK RG * **Unsteady flow in pavement drainage design** , IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * v1 431-444 * Can Soc Civ Eng * (1983).

Storage in roadisde channels is possible for reduction of peak runoff rates. Also, benefits from reduced pollution of storm runoff may result. Use of these channels for storage requires a flow control feature. Also, modification of the design procedure is needed so that the dual purposes of storage and conveyance are achieved without erosion. The Kinematic wave method is useful for the analysis of the flow. However, in that region of the channel flow where backwater effects occur, this method cannot be used. Alternative procedures for analysis are proposed.

062364
WEATHERBE D, MARSALEK J, ZUKOVS * **Research and practice in urban runoff in Canada** * J Tech Counc * 108(TC2) 226-240 * Am Soc Civ Eng * 1982-11.

Much of the research of the 1970's has entered into the practice of urban runoff control in Canada. Urban runoff quality inputs on the Great Lakes are slight; although additional research into organic trace contaminants is needed. Urban rainfall-runoff modelling has concentrated on design storms and hydraulic aspects mostly for use in design. Quantity control technology includes inlet and storage devices with quality control limited to consideration of ponds as settling devices, sometimes with chemicals added. Comprehensive river basin studies typically consider urban drainage effects. Municipal drainage guidelines generally require consideration of the major and minor system. Continued research needs in urban runoff quality and quantity would be assisted by establishment of research catchments for long-term monitoring.

062853
WISNER PE (ED) * **Proceedings of Stormwater and Water Quality Management Modeling Users Group Meeting, 18-19 October, 1982** * 274p * Univ Ottawa, Ottawa, Ont K1N 9B4 * 1983-04.

Fifteen papers, presented at the conference, are included with a heavy emphasis on model studies. Papers on models involved in stormwater and water quality management include SWMM modelling for the Detroit 201 final facilities plan, calibration strategies for SWMM modelling of a combined sewer system, infiltration/inflow modelling for the East Bay, issues related to mathematical water quality modelling management, Requal - a tool for analysis of combined sewer overflows, development and application of Edmonton sanitary trunk system model, integrity of rainfall time series for model of existing combined sewer systems, using models to evaluate alternatives for surcharge sewers, mathematical modelling of coliforms in combined sewer discharges, receiving water quality data base for model testing, and the Piscataway Creek Watershed Model - a stormwater and nonpoint source management tool, and the IMPSWMM procedures for urban drainage modelling with some applications. Three papers evaluate the performance of SWIRL concentration and of inflow/infiltration controls for Stratford, Ontario, and described a dual purpose detention tank for pollution control and flood relief, respectively.

062858
WISNER PE * **The IMPSWM procedures for urban drainage modelling and some applications** , IN: Proc of Stormwater and Water quality Management Modeling Users Group Meeting, 18-19 October, 1982 * WISNER PE * 225-248 * IMPSWM, Univ Ottawa, dep Civ Eng, Ottawa, Ont K1A 9B4 * 1983-04.

Elements of the IMPSWM (Implementation of Storm Water Management) program started in 1978 at the University of Ottawa to study discrepancies between lumped modelling in Phase 1 - a Master Drainage Plan, and detailed modelling and Phase 2 - the Storm Water Management Plan, a two-phase study program for which a large number of municipalities require drainage criteria. Phase 1 constitutes a drainage plan for a large area, usually a community or a small watershed, while Phase 2 consists of a detailed analysis for each subdivision of storm sewer networks, individual storage outlets and overland flow on streets. Five parts of the IMPSWM procedures include: a general presentation of new trends in Canadian urban drainage; a review of design storms; an improved rational method; a method for master drainage plans (OTTHYMO); and, a model for dual drainage analysis (OTTSWMM). Procedures of OTTHYMO, a model for master drainage and flood control plans in small watersheds, and OTTSWMM, a model for analysis of sewer networks and dual drainage systems, are discussed.

065790
WISNER PE, TOWNSEND RD * **Summary and discussion paper on report contributions** , IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * v2 919-932 * Can Soc Civ Eng * (1983).

Several papers prepared by the members of the CSCE stormwater management committee present the subject matter from various viewpoints and on the basis of current practices in different provinces. This general report covers only these papers and does not attempt to give a comprehensive state of the art report of stormwater management in Canada. Some of the main aspects discussed

are the relation between stormwater management and watershed planning for erosin and flood control, different policies, runoff quality monitoring, long and short term mission-oriented studies and the approach to design storms. The general conclusion is that stormwater management has entered a second plase where studies are becoming increasingly complex and more efforts for research are imperative.

4.4 Lakes and Large Bodies of Water - Lacs et grandes etendues d'eau

065102
ALTA ENVIRON, TECH SERV DIV * **Alberta lakes and reservoirs reference index 1980** * 27p * Alta Environ, Tech Serv Div, 10th floor, Oxbridge Place, Room 1030, 9820 - 106 St, Edmonton, Alta T5K 2J6 * (1980).

This publication is the 1980 edition of the Reference Index for data collected and hydrographic surveys carried out by Alberta Environment on selected lakes and reservoirs in the Province. Headings used in the tabulation are: name of lake or reservoir; location, water level; bathymetric maps available for some lakes; area and capacity of the lake; and, remarks. In order to present the user with a comprehensive list of lakes and reservoirs being monitored in the Province, other known data sources are included.

062335
BARTONE CR, SCHELSKE CL * **Lake-wide seasonal changes in limnological conditions in Lake Michigan in 1976** * J Great Lakes Res * 8(3) 413-427 * 1982.

Data collected on lake-wide cruises in 1976 were used to study seasonal and vertical variations in water temperature, transparency, chlorophyll a, and nutrients in Lake Michigan. Data were analyzed according to subsets corresponding to the northern and southern open lake. Comparisons (t-tests) of data from the open lake indicated that the average water temperature was cooler and average water transparency was greater in the northern lake than in the southern, but with the exception of total phosphorus, average nutrient concentrations did not differ between the northern and southern parts. It was found that physical-chemical characteristics of nearshore and Straits of Mackinac stations differed significantly from open lake stations. Seasonal phytoplankton dynamics in the open lake were related to seasonal and vertical changes in silica and nitrate nitrogen. The spring phytoplankton bloom occurred before the lake was strongly stratified thermally. After thermal stratification was well developed, epilimnetic concentrations of chlorophyll a decreased, probably due to some combination of nutrient limitation and zooplankton grazing, and maximum chlorophyll a concentrations were found below the thermocline. Epilimnetic silica concentrations decreased after thermal stratification and diatoms were replaced in the phytoplankton assemblage by green and blue-green algae in late summer. Total phosphorus averaged only 8 micro g/L on a lake-wide basis and thus only small but significant reductions in absolute concentration can be expected from phosphorus control programs. However, over a period of several years, these small reductions in concentration may be difficult to verify from total phosphorus measurements which have relatively large sampling errors and variances.

062233
BOYCE FM, LAM DCL * **The physical limnology of the North American Great Lakes** , IN: Proc Int Assoc Theor Appl Limnol Congr, Japan, 1980 * v21 p1650-1665 * E Schweizerbart'sche Verlagsbuchhandlung, D-7000 Stuttgart 1, DE * 1981-12.

A decade ago the main thrust of physical research on the Great Lakes focussed on the problems of measuring, describing and modelling the large scale circulation of the main basins. The present emphasis in environmental studies is much more toward applied or practical work. More attention is given to the local impact of a shoreline activity. There has been a large effort towards developing methods of predicting mean effluent concentrations in the nearshore zone where the ambient currents and temperatures are viewed as a sort of nearshore "climate". In terms of the basinwide study, the lake modelling effort seems to have entered a more reflective and self-critical phase as chemists and biologists realize that the experimental basis on which the modelling framework rests has an essential physical component. More attention has been paid to physical processes which have a direct bearing on nutrient transfers such as diffusion or turbulent entrainment. A focus for recent studies is the supply of dissolved oxygen to the hypolimnion of the central basin of Lake Erie.

062568
BROCHU M * **Equations for aquatic systems, Meshing models with math** * Sci Dimension * 14(1) 16,18 * 1982.

The National Research Council's Hydraulics Laboratory has developed a promising new solution to the general problem of modelling large bodies of water. It involves a hybrid modelling technique which combines sophisticated, two-dimensional mathematical models of very large areas with detailed physical models of adjacent, limited areas where modifications are planned. To demonstrate the feasibility of this technique such a model was developed of a large section

of the Bay of Fundy. In operation, large computer-controlled pumps fill the model with a simulated tide, with the inflows of water corresponding to data provided by the numerical model. Tide level information in the physical model is then gathered by sensors and fed back to the numerical model. The hybrid model is then verified with actual tidal data from the area being simulated. To find out what happens to the tidal regime when a power plant barrage is built in the upper reaches of the Bay, engineers will simply modify the model accordingly, and observe the resulting perturbations. Once the validity of the hybrid modelling technique has been established, NRC will transfer it to private industry and other research groups involved in future studies of power development in the Bay. A brief description is given of a tidal powerplant now under construction in the estuary of Nova Scotia's Annapolis River on the south side of the Bay of Fundy.

064677
CANFIELD DE, LANGELAND KA, MACEINA MJ, HALLER WT, SHIREMAN JV, JONES JR * **Trophic state classification of lakes with aquatic macrophytes** * Can J Fish Aquat Sci * 40(10) 1713-1718 * 1983-10.

We developed an approach for assessing the trophic status of lakes having growths of aquatic macrophytes because conventional criteria for classifying trophic state emphasize conditions in the open water and ignore the nutrients, plant biomass, and production associated with macrophytes. We propose that a potential water column nutrient concentration be determined through adding the nutrients contained in macrophytes to those in the water. Potential nutrient concentrations can be used in existing indices to classify lake trophic status. This approach permits a first approximation of the potential impact of macrophytes on lake trophic state.

064673
COLLINS NC, SPRULES WG * **Introduction to large-scale comparative studies of lakes** * Can J Fish Aquat Sci * 40(10) 1750-1751 * 1983-10.

After 3 years of gathering comprehensive physical, chemical and biological data from about 40 Ontario lakes to establish empirical relationships between lake ecosystem structure and stresses such as fisheries exploitation, acidification, and nutrient loading, participants were invited to discuss some of the general patterns revealed by the broad-scale comparative approach. The discussion took place at the annual meeting of the American Society of Limnology and Oceanography, June 1982, in Raleigh, North Carolina at a symposium on Large-Scale Comparative Studies of Aquatic Systems.

064117
DONALD DB, DE HENEAU AM * **Limnological studies in Jasper National Park, Part Eight: A limnological survey and management study of 23 lakes near the icefields parkway** * 222p * Can Wildl Serv, 1000, 9942-108 St, Edmonton, Alta T5K 2J5 * 1981.

This report is one volume in a series of reports that examine various aspects of the limnology of lakes and streams in Jasper National Park. Limnological data collected from 23 lakes in the icefields parkway area of Jasper National Park are summarized and information on the physical and chemical aspects of these lakes as well as data on the planktonic, benthic and fish communities, are presented. A detailed analysis and review of factors related to rainbow trout growth in the Park is also presented. This analysis led to a review of the stocking policy for Jasper National Park, and new recommendations on stocking rates for rainbow trout are included in this report. The taxonomic status of one group of invertebrates, the oligochaetes, is examined in greater detail than in previous reports in this series. 19 species were identified, 8 of which have not been previously recorded for Alberta, and 2 of the 8 were new distribution records for Alberta. Of the 23 lakes surveyed, 12 supported salmonid populations maintained by natural recruitment and 5 did not support natural recruitment but have a high potential for rainbow trout growth and production.

067133
DONALD DB, STRACHAN JE, ANTONIUK GA * **Limnological studies in Jasper National Park, Part nine: Evaluation of the 1980 stocking program, Jasper National Park** * 15p * Environ Can, Can Wildl Serv, No 1000, 9942 - 108 St, Edmonton, Alta T5K 2J5 * 1982.

In June 1980, 19 lakes in Jasper National Park were stocked with fingerling rainbow trout. These fish were marked by removing the right pectoral fin. In the following two years 10 of the 19 lakes were surveyed in order to evaluate the 1980 stocking program. About 66% of the 1980 year class could be identified in 1981 and 1982 from the appearance of the right pelvic fin. The marking program does provide a useful method for identifying a particular year class. Growth of the 1980 year class in most lakes ranged from acceptable to exceptional. In most lakes, fish became vulnerable to angling during their second summer. Growth and survival were adequate in Celestine, Christine, Dorothy, Hibernia, and Virl lakes. These lakes should be stocked on an annual basis. Growth or survival was inadequate in Buck, Edith, Hidden and Horseshoe lakes. For these lakes, stocking should be discontinued (Buck?, Hidden, Horseshoe) or should be modified to enhance recruitment (Edith).

065352
FREE BM, MULAMOOTTIL GG * **The limnology of Lake Wabukayne, a storm-water impoundment** * Water Resour Bull * 19(5) 821-827 * 1983-10.

The limnology of a 1.9-ha storm-water detention pond is described. The eutrophic nature of this impoundment is attributed to the nutrients in runoff from the surrounding residential area. During the summer, photosynthetic activity of the phytoplankton caused surface waters to become super-saturated with oxygen, while decomposing organic material greatly reduced dissolved oxygen concentrations in the deeper water. Sediment derived from construction activity within the drainage basin caused the impoundment to be turbid. Tne use of road deicing salts within the drainage basin produced high chloride concentrations and a temporary meromixis during the winter and early spring. The benthic fauna consisted primarily of oligochaetes, chironomids, and chaoborids. High densities of oligochaetes were present in the settling basin. Chaoborid larvae were abundant in the deep basin where low oxygen concentrations reduced the numbers of other benthic macroinvertebrates.

F10587
GROUPE DE MODELES ECOL, UNIV DE SHERBROOKE, QUE * **Rapport d'etape** * 28p * Univ de Sherbrooke, Que * 1982-01.

En septembre 1977, un groupe de professeurs du Departement de genie chimique de la Faculte des sciences apliquees de l'Universite de Sherbrooke, entreprenait des travaux de modelisation du reservoir Desaulniers, sur le territoire de la Baie James. Le present rapport fait le detail des travaux effectues durant l'annee 1981. Il comporte deux sections principales soit, d'une part, les travaux mathematiques realises, et, d'autre part, les diverses simulations des aspects biotiques (productivite planctonique, du benthos, deplacement et dispersion des poissons, decomposition de la matiere vegetale et relargage des sols inondes).

F10463
GROUPE DE MODELES ECOL, UNIV DE SHERBROOKE, QUE * **Rapport d'etape** * 19p * Univ de Sherbrooke, Que * 1980.

En septembre 1977, un groupe de professeurs du Departement de genie chimique de la Faculte des sciences appliquees de l'Universite de Sherbrooke entreprenait des travaux de modelisation du reservoir Desaulniers sur le territoire de la Baie James. Ce projet visait l'utilisation de techniques mathematiques pour la modelisation et la simulation de certains aspects de l'environnement aquatique et d'ecosystemes. Le present rapport fait etat des resultats obtenus depuis le debut des travaux. Il fait ressortir les principales activites du sous-projet en insistant sur l'interrelation existant tout au long des travaux. La pose d'un tel modele peut s'averer, sous certaines conditions, un outil apte a predire l'impact de certaines activites humaines ou d'elaborations industrielles et peut aussi devenir un outil de gestion des ressources naturelles.

065478
HAMMER UT * **Limnological studies of the lakes and streams of the upper Qu'Appelle River system, Saskatchewan, Canada, II: Phytoplankton primary production and algal species abundance and occurrence** * Hydrobiologia * 99(2) 125-144 * 1983-03-11.

High phytoplankton productivity characterizes the eutrophic lakes of the upper Qu'Appelle River system. Annual primary production varied from 187 to 561 g C per sq m while daily areal production varied from 290 to 8575 mg C per sq m. The A sub max range was 164 to 315 mg C per cu m per h with the highest rates usually occurring in August or September. A sub max values on any given day normally occurred in the top 0.5 m. Blue-green algae (Aphanizomenon flos-aquae, Microcystis aeruginosa, Oscillatoria prolifica) dominated the phytoplankton communities during the summer and fall. Diatoms (Asterionella formosa, Fragilaria capucina, Stephanodiscus niagarae) often dominated the spring communities but sometimes persisted as dominants through the summer. Fragilaria on occasion was present at very high concentrations in the late fall. Ceratium hirundinella was sometimes dominant but was usually an important part of the biomass. Green algae, although always present, rarely formed an important part of the biomass with Pediastrum duplex the only exception. A species list is appended.

064005
HOLLAND JZ, CHEN W, ALMAZAN JA, ELDER FC * **Atmospheric boundary layer** . IN: IFYGL - The International Field Year for the Great Lakes * AUBERT EJ, RICHARDS TL * 109-167 * Natl Oceanic Atmos Adm, Great Lakes Environ Res Lab, US Dep Commer, Ann Arbor, MI 48104 US * 1981-03.

This chapter describes the International Field Year for the Great Lakes Atmospheric Boundary Layer Program whose objectives for Lake Ontario were: to determine lake-air fluxes of heat water vapor, momentum, and trace substances, and the distribution and variability of these fluxes in time and space; to develop improved methods of estimating lake-air fluxes based on simple observations; to produce a data set that could be used to test theoretical and numerical models of the behaviour of the atmospheric boundary layer over the lake and its interactions with atmospheric processes of larger scale and with the lake circulation below. Patterns of variation of the meteorological variables in the surface layer, and the structure and

physical processes in the planetary boundary layer on the lake scale and in relation to the adjacent land areas, are described. The micro-meteorology of the lake is discussed, and findings with respect to surface layer profiles of wind, temperature and humidity, the magnitudes and spectra of turbulent fluctuations and their scaling and parameterization, and the mathematical representation of turbulent transfer processes, are presented. Estimates of the magnitudes, distribution, and variability of lake-air fluxes of heat, water vapor, momentum, and sulphur dioxide are summarized, and special studies of energy-transfer episodes in the fall season, are reviewed. Recommendations for further research are also presented.

F11591
KWIATKOWSKI RE, NEILSON MAT * **Donnees recueillies lors de la surveillance du lac Ontario (1968 a 1980)** * Etude no 126, Rapp tech * 69p * Approvision et serv Can, Ottawa, Ont * 1983.

D'apres le calendrier du Programme international de surveillance des Grands Lacs etabli par la Commission mixte international, le lac Ontario est l'objet d'etudes intensives depuis 1968. Des mesures de divers parametres physiques, chimiques et biologiques y ont ete prises. Le present rapport renseigne sur l'emplacement des stations utilisees, la frequence des echantillonnages et la liste des parametres mesures au cours des expeditions effectuees de 1968 a 1980 dans le cadre du programme de surveillance. Pour chaque expedition sont presentes, en les ponderant en fonction du volume du lac entier, les valeurs de la temperature et de la conductivite ainsi que la concentration de l'oxygene dissous, du phosphore total, des nitrates et nitrites, de la silice reactive soluble et la concentration corrigee de la chlorophylle.

F10536
LAVERDIERE C, GUIMONT P * **Le reservoir Caniapiscau, etude du milieu physique, rapport de reconnaissance et de synthese** * 125p * Soc dev de la Baie James, Montreal, Que * 1982-03.

A la suite d'une campagne de reconnaissance effectuee dans la region qui constitue depuis 1980 une partie du reservoir Caniapiscau sur le territoire de la Baie James, les auteurs presentent trois aspects de la geographie physique de cette region: 1) le cadre naturel; son unite physiographique, le soubassement rocheux et les formations superficielles, le climat froid et humide, le couvert vegetal boreal et arctique 2) les grands ensembles geographiques: la region du lac Caniapiscau, les lacs Vermeulle et Clairambault, la zone mitoyenne ou d'interfluve 3) le relief glaciaire particulier et l'interpretation des indices de la disparite des glaces. L'annexe cartographique de l'etude fait l'objet d'un second volume.

F10776
LEBLOND A, ORVIG S * **Une definition plus appropriee de la thermocline lacustre saisonniere** * Atmos-Ocean * 20(4) 317-326 * 1982.

Une definition amelioree de la thermocline lacustre permettant de minimiser les fluctuations de type aleatoire est elaboree afin d'etablir des modeles de prediction plus precis de l'energie interne des lacs. La demarche consiste d'abord a preciser les frontieres de la zone de transition thermique, dite "zone thermoclineale", puis a definir le plan de la thermocline en calculant sa profondeur a partir des temperatures ou encore a partir des profondeurs aux limites de cette zone. Six nouvelles definitions, chacune empruntant plus ou moins aux concepts existants dans la litterature, sont comparees avec la definition de Bronsted et Wesenburg-Lund. Les meilleures definitions sont celles pour lesquelles le plan de la thermocline est defini a partir de la moyenne des temperatures aux frontieres de la zone thermoclineale et parmi ces dernieres, la plus satisfaisante est celle obtenue d'un gradient moyen limite a environ deux fois la profondeur de la thermocline.

064669
LEWIS WM * **A revised classification of lakes based on mixing** * Can J Fish Aquat Sci * 40 * 2 tab, 2 fig, 44 ref * 1983-10.

Deficiencies in the Hutchinson-Loffler classification of lakes based on mixing are reviewed and organized under the following headings: (1) exclusion of shallow lakes, (2) unsatisfactory relationship between meromixis and the six basic types, (3) excessively complex treatment of tropical lakes, and (4) difficulties in classification of cold lakes due to the 4C boundary on cold monomixis. A revision remedies these deficiencies with minimal changes in terminology and conceptual foundation of the original classification. The revision incoroporates the following features: (1) the meromixis/holomixis dichotomy is combined with the six lake types based on seasonal mixing in such a way that the two systems are hierarchical and universal; meromictic lakes are assigned to a seasonal type on the basis of the behavior of the upper water column, (2) oligomixis is eliminated, (3) shallow lakes are brought under the classification by definition of four polymictic types based on ice cover and frequency of mixing.

F11049
MARCOTTE N * **Reservoir Bienville etude du regime thermique** * 93p * Hydro-Que, Montreal, Que * 1980-01.

La presente a pour but la prevision des

temperatures de l'eau au cours des mois d'hiver dans le futur reservoir Bienville ainsi que dans un court segment de la riviere Grande Baleine a l'aval de l'executoire de ce reservoir. Cette etude se situe dans le cadre du projet d'amenagement hydroelectrique Grande Baleine. Le modele mathematique de simulation utilise pour cette recherche presente toutefois les resultats de simulation pour tous les mois de l'annee. Les donnees relatives au regime thermique sont fournies separement pour le lac Bienville et la riviere Grande Baleine selon: le calcul a l'etat naturel, les observations sur le terrain, le calcul apres amenagement.

063588
NICHOLSON HF * **Bibliography of the limnology and fisheries of Canadian freshwaters, No.2 (revised)** * 82p * Can Cent Inland Waters, Great Lakes Biolimnol Lab, 867 Lakeshore Rd, Burlington, Ont L7R 4A6 * 1982.

A revised bibliography of limnology and fisheries of Canadian freshwaters is divided into two sections: the reference index and the freshwater feature index in alphabetical order of provinces and freshwater feature names.

065465
NORTHCOTE TG, HALL KJ * **Limnological contrasts and anomalies in two adjacent saline lakes** , IN: Saline Lakes, Proc 2nd Int Symp on Athalassic (Inland) Saline Lakes, Saskatoon, Sask, June 24-28, 1982 * HAMMER UT * Hydrobiologia * v105 179-194 * 1983-09-01.

Differences in physical, chemical, and biological conditions in two small (less than 20ha) saline lakes less than 1 km apart in south-central British Columbia are examined. Although the lake basins are morphometrically similar, differences in their watershed geology and topography in large part may be responsible for the more saline lake showing severe and anomalous meromictic features while the less saline lake exhibits normal dimictic characteristics. Bacterial and phytoplankton population densities and production profiles of the lakes are compared along with some aspects of their zooplankton populations.

064004
PINSAK AP, RODGERS GK * **Energy balance** , IN: IFYGL - The International Field Year for the Great Lakes * AUBERT EJ, RICHARDS TL * 169-197 * Natl Oceanic Atmos Adm, Great Lakes Environ Res Lab, US Dep Commer, Ann Arbor, MI 48104 US * 1981-03.

This chapter describes the International Field Year for the Great Lakes Energy Balance Program whose objectives were to: define the general and specific properties of the energy balance of Lake Ontario and evaluate all the terms in the heat budget for the 1972-73 Field Year; provide estimates of evaporation as a residual of the energy balance equations for comparison with estimates made by other techniques; and, study the formation, growth and decay of ice, including heat transfer from water to the atmosphere through the intervening ice and snow. Results of the Program indicate that: extrapolation of radiation observations produced estimates of lake net radiation flux that are not significantly different from results obtained with an atmospheric radiation model in which observations of clouds, temperature and moisture were used and the effect of fog was included; heat transport increases in significance with decreasing averaging intervals; the energy balance synthesis is affected by the accuracy of the assumptions made and the data used to estimate the terms; density of radiation measurements and observations of cloud height are not as critical as fog occurrence and distribution and fog thickness; change in heat storage due to ice formation and decay is significant; and, a key element is the partitioning of the residual latent plus sensible heat flux by use of the Bowen ratio. It is concluded that the energy balance technique is a useful approach to calculate lakescale evaporation.

064399
SLADECEK V (ED) * **International Association of Theoretical and Applied Limnology, Proceedings, Vol 21, Japan, 1980** * 1864p * E Schweiz Verlagsbuchhandlung, D-7000 Stuttgart 1, DE * 1981.

The proceedings are presented under the theme "For a better freshwater environment". The subjects include detailed scientific sessions on population and community dynamics, physiology, behaviour, and distribution of phytoplankton and zooplankton, nutrient dynamics and fertilization effects, eutrophication, microbial ecology, decompositon, physical parameters and hydrodynamics, ecosystem structure and functoining, modelling, ecology of river ecosystems, water quality and pollution, geochemistry, paleolimnology, zoobenthos, and fish ecology. Plenary lectures addressed nitrogen metabolism and sewage control for relieving water pollution. Part I contains papers on physical limnology, chemical limnology, lakes of North America, Europe, Asia, and Australia, Oceania and Antarctica. Part II contains papers on lakes of South America, and Africa, paleolimnology, methods, running waters, man-made lakes, applied limnology, small water bodies1, and fish and fisheries. Part III contains papers on ecology of aquatic organisms including bacteria, algae and other plants, and animals, and North American Great Lakes, a symposium of invited papers.

064152
WATER SURV SECT, SURV BRANCH, TECH SERV DIV, ALBERTA ENVIRON * **Alberta miscellaneous lake levels 1979** * 404p * Alberta Environ, Tech Serv Div, Surv Branch, Water Surv Sect * 1981-05.

Over the years Alberta Environment has collected lake level information at numerous lakes throughout the Province. As of 1979 there were 202 lakes being monitored. Historically this information has been collected for internal use and filed in the Technical Services Reference Centre. In an effort to present these data in a more convenient form, and make them available to more users, it was decided to produce an annual summary of the information gathered. The data report is the first in a series to be produced and contains all the miscellaneous lake level data collected by the Technical Services Division in 1979. A report containing the 1978 lake level data will be released simultaneously. For 1980 and subsequent years it is intended that the data be published on an annual basis. It should be noted that continuous lake level data collected by Water Survey of Canada, Alberta Environment and various contributing agencies is published separately by Water Survey of Canada, Calgary in their annual publication Surface Water Data, Alberta. A list of the lakes is presented.

064135
WICKSTROM RD * **Kotanee studies 1980, Kluane National Park** * 25p * Can Wildl Serv, 1000, 9942-108 St, Edmonton, Alta T5K 2J5 * 1981-03.

This report, on the first season of a two-year project which began in 1980, collects and analyzes biological and limnological information for the preparation of kokanee (Oncorhynchus nerka) management plan for the Kathleen lakes chain (Kathleen, Louise and Sockeye lakes) in Kluane National Park. The creel vensus project, which provides quantitative information on the extent of the angler harvest of kokanee as well as other related data on both kokanee and anglers, is described. Spawning enumeration of kokanee, following a procedure whereby the observer, commencing counting from a fixed point just downstream from the lowermost fish in the spawning area, counted kokanee as he walked along the south bank of the stream towards the lake, is outlined. Physical measurements (temperature, specific conductivity, Secchi disk, water stage) of the lakes are presented to illustrate kokanee habitat and general limnological conditions. This report is preliminary as the data are to be upgraded and expanded in the 1981 season and incorporated in a final report.

4.5 Flow Regulation - Regularisation des debits

064634
Lesser Slave Lake Regulation, Environmental Impact Assessment, Volume VI, Social impact studies * vp * Alta Environ, Plann Div * (1980).

This volume of the Lesser Slave Lake Regulation, Environmental Impact Assessment consists of two appendices. Appendix Six, Archaeological Impact, describes an historical resources impact assessment of the area to be impacted by the construction of a canal and weir at Lesser Slave Lake. Four historic resources sites were located in the area. Two isolated finds, a quartzite flake and biface fragment, were removed at the time of the survey. One of the remaining sites would be destroyed by excavation of the canal bottom, while the other would be badly disturbed by ancillary activities such as vehicular storage and access to construction areas. Due to the paucity of cultural material, no further mitigative measures are recommended. Appendix Seven, Community Impact, provides information on the social and community impacts that can be expected to result from the water control project. It identifies the ways that the project is perceived by area residents as well as the potential positive and negative social impacts to the people living in the communities and Indian Reserves in the Lesser Slave Lake region.

064631
Lesser Slave Lake Regulation, Environmental Impact Assessment, Volume III, Land use impact studies * vp * Alta Environ, Plann Div * (1981).

This volume on land use impact studies consists of three appendices. Appendix One reports on possible hydrologic effects of the Lesser Slave Weir and Canal. Water levels in the lake are described and the rate of drop of spring flood levels is recorded and analyzed. The flushing rate of the lake is described as well as the probable shoreline sediment drift. The probable increase in gradient of inflowing streams due to lowering of the main lake level is discussed and probable consequences such as increased river degradation, movement of deltas and sediment load are noted. A description is given of the Buffalo Bay area following completion of the project. Tributary characteristics and potential impacts are listed. Appendix Two describes an investigation into the groundwater conditions at the east end of Lesser Slave Lake and predicts the potential effect of the canal operation on local groundwater and lake levels. Appendix Three presents land use studies. It inventories existing conditions, discusses impacts, and suggests measures for monitoring and minimizing negative impacts. The subject areas considered are land use, agricultural and recreational capability, and vegetation. Procedures for reclamation of areas disturbed during canal and weir construction are outlined.

064630
Lesser Slave Lake Regulation, Environmental Impact Assessment, Volume II, Engineering report * vp * Alta Environ, Plann Div * (1980).

Northwest Hydraulic Consultants Ltd. conducted a study to determine possible schemes to regulate the Lesser Slave Lake elevations within prescribed elevations of 577.6 m and 575.5 m respectively. The hydraulic design of three alternatives was presented: (1) canal only, (2) canal and minor cut-off, and (3) cutoffs only. Highlights of the results of the study are discussed, and memoranda outlining the three alternatives are included as an appendix to this volume. A detailed outline of the geotechnical investigations and design is presented and a summary is given of geotechnical consideration. Estimates for the three alternatives considered are described. The engineering cost estimates are presented in tabular form and detailed cost estimates for each alternative are included. Based on the cost estimates of 8.4 million for the canal and 3.5 to 4 million for the cutoff alternative, the logical choice for construction would appear to be the cutoff alternative.

065499
ALBERTA ENVIRON, PLANN DIV * **Isle Lake/Lac Ste. Anne regulation feasibility study** * 61p * Alberta Environ, Plann Div, 9th Floor, Oxbridge Place, 9820 -106 St, Edmonton, Alta T5K 2J6 * 1980-07.

Isle Lake and Lac Ste Anne are west of Edmonton in the headwaters of the Sturgeon River, a major tributary of the North Saskatchewan River system. This study, a follow-up to recommendations in the 1977 "Interim Report - Sturgeon River Basin Study", addresses the hydrotechnical, social preference and cost factors associated with potential regulation of Isle Lake and Lac Ste Anne. Seven alternative regulation sets were analysed, using a water balance simulation model developed for 1963-77. Study results indicate that the natural historic fluctuation of 1.5 m on Lac Ste Anne could at best be reduced to 1.0 m through regulation. The target level range was 0.5 m. Cost of major regulation works would approach $500,000, with provincial funding of 72%. The historic fluctuation of 1.7 m on Isle Lake could be regulated within 0.8 m. The target level range was 0.6 m. Cost of major regulation works could be about $600,000 and these works would not qualify for government funding. Major regulation of Lac Ste Anne would have significant downstream effect, primarily on amplifying extreme high and low water levels at Big Lake. The primary recommendation is that Alberta Environment not participate in major regulation works for Lac Ste Anne or Isle Lake. The ongoing program of weed and obstruction removal in outlet channels should continue, with local input.

064226
ALTA ENVIRON, PLAN DIV * **Buffalo Lake regulation study, Phase II** * 91p * Alta Environ, Plann Div, 9th Floor, Oxbridge Place, 9820 - 106 St, Edmonton, Alta T5K 2J6 * 1982-08.

The purpose of this report is to assess the technical, economic, environmental, and social feasibility of regulating Buffalo Lake by pumping water from the Red Deer River and conveying it to Buffalo Lake via Parlby Creek. Benefits to recreational development and agricultural productivity, effect on Buffalo Lake water quality, and local attitudes towards the project are some of the issues addressed in this report.

065102
ALTA ENVIRON, TECH SERV DIV * **Alberta lakes and reservoirs reference index 1980** (see chapter 4.4 for complete reference - voir chapitre 4.4 pour la reference complete)

062633
BEAK CONSULT LTD, ATL DIV * **Cat Arm hydroelectric project, Environmental impact assessment, Fisheries resource study** (see chapter 4.13 for complete reference - voir chapitre 4.13 pour la reference complete)

062271
BECHARD D, CORBU I, GAGNON R, NIX GA, PARKER LE, STEWART K, TRINH M * **The Ottawa River regulation modeling system (ORRMS)** . IN: Int Symp on Real-time Operation of Hydrosystems, June 24-26, 1981, Univ Waterloo, Ont, Proc, Vol I * UNNY TE, MCBEAN EA * 179-198 * Univ Waterloo, Waterloo, Ont * (1981).

A linear-separable programming model was developed to allow an integrated operation of the reservoirs located in the Ottawa River basin. The model could optimize the operation of the river for reducing flood damages only, or for energy purposes only, while respecting constraints on flows and levels imposed by other interests such as recreation, navigation, log driving, etc. It also allows trade-offs between the sometimes contradictory objectives of flood protection and energy generation. The model has been developed mainly to facilitate the operation of the Ottawa River. However, it could also be used for other applications such as determining the impact of new reservoirs, assessing the effect of new constraints, etc. Although the model was developed specifically for the Ottawa River, it is generalized and the computer program could be applied directly or with only minor enhancements to other river systems.

F10945
BOUCHER R, LEMIRE R * **Description generale du bassin de la riviere Desaulniers et des stations echantillonnees en 1976, 1977 et 1978** (see chapter 2 for complete reference - voir chapitre 2 pour la reference complete)

066973
BRAGA BPF, LINSLEY RK, FRANZINI JB * **The value of real-time streamflow forecasting for multi-objective reservoir operation** , IN: Decision making for hydrosystems: forecasting and operation, Int Symp on Real-Time Operation of Hydrosystems, Waterloo, Ont, 24-26 June 1981 * UNNY TE, MCBEAN EA * 63-87 * Water Resour Publ, PO Box 2841, Littleton, CO 80161 US * 1982.

Over the past 10 years a large number of streamflow forecasting models have been reported in the literature. More recently, these models are increasingly being used in the real-time operation of water resources systems. This paper describes a decision model to help a reservoir manager choose from different streamflow forecasting systems the one which is best according to his preferences. The operation is treated as a problem with multiple objectives under uncertainty and decision analysis is used in the development of the model. The reservoir manager's preferences are encoded through a multiplicative multi-attribute utility function. The decision model is used to explore the value of real-time streamflow forecasting. A perfect one-day ahead forecast is assumed to establish upper boundaries for results that can be obtained by the use of available streamflow forecasting models.

F10457
CARTER D * **Etudes hydrologiques complementaires, troncon Brisay-Vipart, rapport de synthese** * 28p * Soc energie de la Baie James, Montreal, Que * 1980-08.

Dans le cadre des etudes sur les repercussions ecologiques que peut entrainer la variation des debits de la riviere Caniapiscau entre l'ouvrage regulateur de Brisay et la bassin de Fontanges, ce rapport s'interroge sur l'opportunite d'implanter a l'executoir du lac Roitelet des deversoirs et des digues. Trois aspects sont consideres: 1) determination des caracteristiques et de l'envergure des travaux necessaire 2) identification des releves topographiques pre-requis a la poursuite des etudes 3) prevision des niveaux d'eau probable suite a l'eventuelle implantation d'ouvrages a l'executoire du lac Roitelet.

065776
CHANTLER AG * **Settling ponds at Line Creek coal mine, British Columbia** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

063621
CHUA KL * **A simplified approach to calculating storage pond volumes** * Can J Civ Eng * 10(2) 312-316 * 1983-06.

A simplified approach is presented for determining the pond storage volume required in new subdivisions in order to achieve a desired peak outflow rate. The method utilizes the runoff coefficients in the "rational formula" to arrive at the total volume of runoff. The total discharge volume is determined using a pre-determined peak discharge as the maximum outflow rate. The difference between inflow and outflow volumes yields the storage requirement. To optimize the storage volume, the storage function is maximized. Newton's iteration technique is used to arrive at the optimum parameters.

F10472
CLEMENT F, EUGENI R * **Detournement EOL, exploitation du reservoir Opinaca en periode de crues** * 41p * Lalonde, Girouard, Letendre et assoc * 1982-01.

Afin de minimiser les impacts negatifs sur la stabilite des berges et la vegetation riveraine en voie d'implantation, ce rapport etudie les possibilites de reduire au minimum les deversements de pointe du reservoir Opinaca dans la partie aval des rivieres Eastmain et Opinaca. La question est traitee selon 3 volets: 1) presentation d'un jeu de consignes d'exploitation du reservoir en periode de crues, permettant d'etaler les ondes de crues tout en minimisant les pertes d'eau evacuees vers le cours aval des rivieres Eastmain et Opinaca 2) recommandation d'un reseau de surveillance necessaire a l'exploitation adequate du reservoir 3) evaluation de l'influence des deversements sur le regime hydraulique des rivieres Eastmain et Opinaca.

063466
DICKIE LM, TRITES RW * **The Gulf of St. Lawrence, Chapter 16** , IN: Estuaries and enclosed seas * KETCHUM BH * 403-425 * Elsevier Sci Publ Co, Amsterdam * 1983.

The location of the Gulf of St. Lawrence on the eastern seaboard of North America, coupled with the St. Lawrence River, makes it a major avenue for access to the interior of the continent. It is also the setting for important fisheries, oil exploration activities and recreation, despite the fact that it is frequently almost completely covered by ice for two months of the year. In addition, many rivers entering it are subject to extensive and progressive alteration, or "regulation", principally for hydroelectric power generation. The present and potential extent of these alterations seems to pose an example of major direct effect of man on the dynamics of a semi-enclosed sea. It becomes a matter of particular interest to understand, predict and control the consequences of these

man-made modifications.

066097
GRIDLEY NC, LIN KC * **Modelling dissolved oxygen in a proposed reservoir** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

065768
GRYGIER JC, STEDINGER JR * **Algorithms for optimizing hydropower system operation** . IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * v1 465-484 * Can Soc Civ Eng * (1983).

Successive linear programming, an optimal control algorithm, and a linear-dynamic programming approach were employed to optimize the operation of multireservoir hydrosystems. The algorithms maximized the value of energy produced at on-peak and off-peak times, plus the estimated value of water remaining in storage at the end of a 12-month planning period. The linear-dynamic programming algorithm was clearly dominated: it took longer to find a solution and the final objective value was often significantly below the optimum. Successive LP appeared to find the global maximum and was easy to implement. By comparison, the optimal control algorithm reached or came close to the optimum in about one fifth the time of SLP but was harder to implement. Computing costs for a two-reservoir, twelve-month deterministic problem averaged about seven cents per run using optimal control and thirty-seven cents using successive linear programming.

066974
HINTON BC, UNNY TE * **Risk assessment in real-time operation** . IN: Decision making for hydrosystems: forecasting and operation, Int Symp on Real-Time Operation of Hydrosystems, Waterloo, Ont, 24-26 June 1981 * UNNY TE, MCBEAN EA * 89-113 * Water Resour Publ, PO Box 2841, Littleton, CO 80161 US * 1982.

The objective of this paper is to present a methodology for the assessment of risk of failure that is in accordance with real-time operational practice. Real-time operation is the period by period operation of the reservoir. Decisions for the next operational period are made on the basis of the current state of the system, the forecast input to the system and the demand for water. At the conclusion of the operational period, the system states are updated and the decision process is continued for the succeeding operational period. An optimization model may be developed to guide the operation, however, it is the perogative of management to accept or to reject this guidance. Risk assessment is made as a means of quantifying the effects of managerial intervention in the implementation of physical operation. Simulation of real-time operation on the computer provides a procedure to obtain a large sample size of operational results from which risk of failure may be calculated. The system used for demonstration purposes is the Conestoga and Shand Dams which constitute the major control structures on the Grand River in Ontario. The primary operational purposes of the reservoir system include flood control and low flow augmentation.

066978
HOLLE FK, LEONHARDT P, LUDWIG K * **Flood forecast in river basins with regulation systems** (see chapter 4.2 for complete reference - voir chapitre 4.2 pour la reference complete)

066970
HOWARD CDD * **Forecasting the effects of severe rainfall runoff on reservoir release routing** . IN: Decision making for hydrosystems: forecasting and operation, Int Symp on Real-Time Operation of Hydrosystems, Waterloo, Ont, 24-26 June 1981 * UNNY TE, MCBEAN EA * 585-602 * Water Resour Publ, PO Box 2841, Littleton, CO 80161 US * 1982.

A comprehensive routing of transient reservoir releases including the effects of downstream tributary hydrographs can be accomplished using a method of characteristics solution to a kinematic wave formulation for both the main channel hydrodynamics and the forecasting of tributary inflow hydrographs. With practical assumptions which recognize the actual data availability, a real-time operational method can be implemented for a programmable hand-held calculator or desk-top microcomputer. The method, as implemented, has four components: (1) Forecasting of the tributary hydrographs based on real-time observation of the rate of change of their discharge. (2) Calculation of a travel time and wave speed for the accelerating wave front during the forecasted runoff event. (3) Definition of the impulse response functions which transform the reservoir release pattern to a routed hydrograph at the downstream point of interest. The variability in this function for different runoff events depends primarily on the wave speed. (4) Superposition of the routed hydrograph and the unregulated runoff.

066082
KLEMES V * **Pruning the models for storage reservoir analysis** . IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * v1 179-195 * Can Soc Civ Eng * (1981).

Many different models and techniques are being used in storage reservoir analysis. They can be grouped into two broad categories, 1) flood routing models for the transformation of streamflow by uncontrolled reservoir storage, and 2) storage-yield, or release-

rule, models for forced streamflow regulation implemented by operation of reservoir outlet gates. For planning and design purposes, the latter group has been further subdivided into the deterministic and stochastic subgroups. It is shown that all these various models can be reduced to a single model which can be used either in a flood routing mode or in a release-rule mode.

065769
KLEMES V * **Climatic change and the planning of water resource systems** , IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * v1 485-500 * Can Soc Civ Eng * (1983).

Storage reservoirs represent the core of most large water resource systems serving flood protection, low-flow augmentation and water supply, and hydro-power generation. Reliable estimation of reservoir effectiveness in controlling the streamflow is thus an important component in the planning and design of water resource systems. This estimation is complicated by the uncertainty in streamflow during the working life of the reservoir, i.e. during a future 50-100 years. Further uncertainties arise in the case of a climate change. In this paper, results of a recent study on the impact of climate change on streamflow are analyzed from the point of view of their statistical significance vis-a-vis the uncertainties in estimates of reservoir effectiveness.

F10890
LAPERLE M * **La protection de l'environnement au Complexe La Grande** , IN: Congres de la Soc can des biol de l'environ, 5 janvier 1981 * 15p * Soc energie de la Baie James, Montreal, Que * 1981.

Dans le cadre du plan de surveillance et d'amenagements correctifs prevus pour la region de LG 2 sur le territoire de la Baie James, l'auteur aborde les grandes lignes des resultats observes pendant le remplissage et la premiere annee d'operation du reservoir de LG 2. Apres avoir presente les mandats de la direction Environnement de la Societe d'energie de la Baie James (SEBJ), l'auteur decrit les modifications apportees par la creation du reservoir sur les parametres suivants: physico-chimie des eaux, oxygene dissous, conductivite, pH, turbidite, phosphore total, azote, chlorophylle, zooplancton, benthos et poissons.

F11651
LARIVIERE R * **Amenagement hydraulique et protection de l'environnement** * 24p * Hydro-Que, Dir environ, Montreal, Que * 1979-11-05.

Les repercussions des amenagements hydrauliques sur l'environnement peuvent se manifester en amont d'un barrage, dans sa retenue, a l'aval du barrage et dans une region entiere. Ces repercussions peuvent etre de trois ordres: physique, biologique et social. Cette etude traite des moyens propres a pallier ces repercussions ou a evaluer l'importance de leurs inconvenients. L'auteur decrit ces repercussions en trois volets: 1) repercussions generales sur l'environnement des rivieres, en presence de glace: augmentation reduction et variation des debits 2) repercussions physiques et biologiques dues a l'obstacle constitue par un barrage, a l'influence des retenues sur l'air et aux repercussions des amenagements sur les eaux a l'interieur et hors de la retenue, aux glissements de terrains provoques et aux seismes induits 3) repercussions d'ordre social, benefiques sur le tourisme ou le loisir, negatives sur les populations deplacees, les terres cultivables, les sites archeologiques.

062753
LONG BF * **Evolution of Outardes Estuary after the hydraulic power regulation** , IN: Proc Canadian Coastal Conf 1983, Vancouver, 11-14 May 1983 * Holden BJ * 327-328 * Natl Res Counc, Assoc Comm Res Shoreline Erosion Sediment, Ottawa, Ont K1A OR6 * 1983.

The Outardes Estuary, located on the North shore of the St. Lawrence Estuary, is a typical subboreal estuary that has been modified by human river regulation during the last two decades (Cataliotti-Valdina and Long, 1983). Before 1965, the river discharge was 2700 cu m per s in spring flood and the dominant river flow was 1350 cu m per s; between 1965 and 1975, it was 430 cu m per s during the damming phase, and now it is 560 cu m per s and artifical peak flow is 1300 cu m per s (1981). The important variation of river discharge changes the sedimentary equilibrium of the model, today the river SPM (Suspended Particulate Matter) flow is very low (56000 t/a) per comparison of a similar river, St-Jean river (250000 t/a) a non regulated river (Long and Cataliotti, 1981).

065473
MACKIE GL, ROOKE JB, ROFF JC, GERRATH JF * **Effects of changes in discharge level on temperature and oxygen regimes in a new reservoir and downstream** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

F10953
NAULT R * **Remplissage du reservoir de LG 2** * 44p * Soc energie de la Baie James, Montreal, Que * 1980-04.

Ce rapport presente les modifications physiques, chimiques et biologiques observees dans le bief d'amont de la centrale de LG 2 situee sur le territoire de la Baie James. Les parametres mesures entre novembre 1978 et

decembre 1979 sont les suivants: couvert de glace, eboulis, debris, debris flottants, tourbieres flottantes, deplacement de la faune et qualite de l'eau.

064155
REG ECON EXPANS, PRAIRIE FARM REHABIL ADM, ENG SERV, ALBERTA REG DIV * **Engineering report, Milk River basin study (1980)** (see chapter 2 for complete reference - voir chapitre 2 pour la reference complete)

063772
SADLER B * **The regulation of the Red Deer River: conflict and choice, Chapter 9** . IN: Water problems and policies * SEWELL WRD, BARKER ML * Cornett Occas Pap No 1 * 91-109 * Dep Geogr, Univ Victoria, Victoria, BC V8W 2Y2 * 1980.

This paper provides insights into the social conflicts and political stress which can develop when elaborate efforts are undertaken to incorporate public concerns into the design of an integrated plan for regional development and water resources management. In a post-audit of the strategic choice process involved in the planning of flow regulation on the Red Deer River, Alberta, this paper examines the impact of different agency roles and objectives in a situation where an attempt was made to graft broadly integrative approaches onto traditional structural solutions. A description is given of the Red Deer River Basin and the problems that have developed from the interaction between human activity and the hydrologic regime that stem largely from flow reductions that occur in the winter months. Water management considerations and proposals are outlined and the role of public hearings in the matter is discussed.

065767
SINGH KP * **Desirable low flow releases from impounding reservoirs** . IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * v1 445-464 * Can Soc Civ Eng * (1983).

Low flow criteria for fish and wildlife need to be developed for determining the relative suitability of various low flow regimes. In order to choose a minimum low flow release which keeps the fishery in good condition and, at the same time, does not unduly saddle the developer with high additional cost, the decision maker needs to know the tradeoffs between benefits to fisheries and costs of extra storage for a range of low flow releases. In order to develop tradeoff curves, the hydraulic geometry parameters were developed at 123 gaging stations in Illinois for 8 low flow releases. The velocity-depth domains in terms of fish preferences for the juveniles and adults of 9 fish species indicate that most of the fish will be in the pools (in pool-riffle sequences) and that the desirable flow environment of some fish is quite different from others. A computer program was developed to compute the required storage to meet demands equal to 2, 5, 10, and 20 percent of mean flow, with no low flow release as well as 8 low flow releases, with design droughts of 25 and 40 years. The program also calculates the individual fish preferences as well as the weighted preference of the target species, both of the juveniles and adults, for the pools as well as riffles. Plots of combined fish preference versus incremental costs to provide extra storage to meet the low flow release during the design drought provide the information for deciding on a suitable low flow release.

065361
SNODGRASS WJ, HOLLORAN MF * **Sensitivity analysis of reservoir oxygen model** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

066077
THOMPSTONE RM, BOUCHARD S, PILON PJ, BERGERON R * **Real-time daily hydrological forecasting for a multi-reservoir hydroelectric system** . IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * v1 37-57 * Can Soc Civ Eng * (1981).

This paper discusses the recent and continuing development of a real-time daily hydrological forecasting system used in the operational management of a multi-reservoir hydroelectric system built and operated by Alcan Smelters and Chemicals Ltd. in the Saguenay - Lac St-Jean region of Quebec. The forecasting system uses a lumped conceptual hydrology model to simulate the relationship between daily meteorological conditions and uncontrolled (natural) inflow to reservoirs from each watershed of interest. The model used is parametric and thus, although a single model is used for all watersheds, it is calibrated to reflect the particularities of each watershed. Meteorological forecasts prepared by the Atmospheric Environment Service of Environment Canada are used along with long-term average meteorological conditions to produce raw inflow forecasts on a daily basis for the next seven days. These raw forecasts are then adjusted according to recent differences between observed inflows and modelled inflows. The "solid accumulation" component of the model can be adjusted in accordance with snow surveys.

065101
TREW DO * **An approach for assessing the impact of lake level fluctuations on lake trophic status, Cold Lake - Beaver River Basin** * 10p * Alta Environ, Pollut Control Div * (1982).

The effects of hydrologic manipulations on the process of eutrophication are studied in 13 Alberta lakes which have a high amenity value and recreational use. Two concerns are highlighted: the increase in nutrient supply through the leaching of nutrient material from either freshly inundated shoreline or from the exposure or organic sediments in the littoral zone which is an important biological and chemical processing component of the lake ecosystem. It is proposed that the lakes be ranked according to their sensitivities to hydrological manipulations and that ranking criteria to based upon the two principal considerations in eutrophication modelling: the effects of nutrient supply and the effects of flushing. The analysis is based upon the absolute physical/chemical characteristics of the study lakes. Results indicate that: all lakes could be negatively affected by in-lake water withdrawals; the effects of nutrient supply changes can be offset by high natural flushing rates, while damage to littoral zone biota cannot; and, the probability of winterkill in the shallow lakes will be increased by drawdown.

066975
TURGEON A * **Optimal short-term scheduling of hydroplants in series - a review** , IN: Decision making for hydrosystems: forecasting and operation, Int Symp on Real-Time Operation of Hydrosystems, Waterloo, Ont, 24-26 June 1981 * UNNY TE, MCBEAN EA * 185-201 * Water Resour Publ, PO Box 2841, Littleton, CO 80161 US * 1982.

This paper reviews certain methods for solving the short-term scheduling problem of hydroplants in series. These methods are the progressive optimality algorithm, the discrete maximum principle and the Rosen's gradient projection method. The methods solve a short-term problem in which water head variation, time delays between upstream and downstream reservoirs, spilling, lower and upper bounds on the state and control variables and the nonlinearity of the cost are taken into account. A limited comparison of the methods is made.

062277
UNNY TE, DIVI R, HINTON B, ROBERT A * **A model for real-time operation of a large multi-reservoir hydroelectric system** , IN: Int Symp on Real-time Operation of Hydrosystems, June 24-26, 1981, Univ Waterloo, Waterloo, Ont, Proc, Vol I * UNNY TE, MCBEAN EA * 284-304 * Univ Waterloo, Waterloo, Ont * (1981).

The energy crisis and soaring oil prices in the past decade have created a tremendous interest in the water resources management and power industry sectors to undertake research projects aimed at developing new technology to improve the efficiency of existing facilities. The present paper is part of an outcome of one such investigation at Alcan Smelters and Chemicals Ltd. that operates a large hydroelectric system in the Suguenay-Lac St.-Jean region of Quebec. The system consists of three major reservoirs, one minor reservoir and six power plants with an installed capacity of 2687 MW. The object of this paper is two-fold: First, to present an application to the Alcan System of the systems analysis technique for the optimal scheduling of reservoirs in real time. Second, to discuss the use of the model developed for evaluating the risk of energy failure in the Alcan system.

066967
UNNY TE, MCBEAN EA (ED) * **Decision making for hydrosystems: forecasting and operation** * 602p * Water Resour Publ, PO Box 2841, Littleton, CO 80161 US * 1982.

Many aspects of decision-making leading to the physical operation of hydrosystems are discussed. Operation in real time is executed on a period-by-period basis and the decisions for operation are made at the beginning of each period. Papers have been chosen and revised, and arranged in 4 subdivisions: Human factors and risk evaluation; Optimization procedures; Models for input data; and Real-time forecasting of input data. There are two broad questions concerning decision making for the operational management of a hydrosystem. How are they making the decision? How should they be making the decisions?

062283
UNNY TE, MCBEAN EA (ED) * **International Symposium on Real-time Operation of Hydrosystems, June 24-26, 1981, University of Waterloo, Waterloo, Ontario, Canada Proceedings, 2 vol.** * 915p * Univ Waterloo, Waterloo, Ont * (1981).

The proceedings of the International Symposium on Real-time Operation of Hydrosystems are presented in two volumes. The symposium was held June 24-26, 1981 at the University of Waterloo, Waterloo, Ontario. Papers presented in Session A pertained to mathematical models for real-time operation. Session B dealt with practical experience with real-time operation of hydrosystems, while papers presented in Session C dealt with real-time operation of water quality and multi-objective water systems. The final session dealt with real-time flow forecasting, flood forecasting, data collection and organizing mechanisms for forecasting.

064161
YUZYK TR * **Lake Diefenbaker, Saskatchewan: a case study of reservoir sedimentation** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

4.6 Water Movement - Mouvement de l'eau

064521
FREEMAN NG, FLEMMING BM, ANNING JL * **La Grande/Great Whale plume measurements data report winter 1979** * Data Rep Ser No 82-3 * 269p * Oceanogr Div, Ocean Sci Surv, Bayfield Lab Mar Sci Surv, Fish Oceans, Gov Can, PO Box 5050, Burlington, Ont L7R 4A6 * 1982-09.

This report contains edited conductivity and temperature profile data, as well as time-series current meter data. The data was collected by Bayfield Laboratory personnel in the freshwater plumes off the La Grande and Great Whale Rivers during the ice-covered period of January and February, 1979. Conductivity and temperature profiles were obtained with a Guideline MKIV CTD probe. Current speed and direction in addition to conductivity and temperature were collected at a series of 18/25-hour stations by means of a modified Aanderaa RCM-4 current meter profiler. In addition, Aanderaa RCM-4 current meters, with in-line vanes, were moored at fixed depths beneath the ice and provided long period time-series records.

061905
HUANG JCK, SAYLOR JH * **Vorticity waves in a shallow basin** * Dyn Atmos Ocean * 6(3) 177-196 * Elsevier Sci Pub Co, Amsterdam, NE * 1982-06.

Observed oscillatory current patterns in the southern basin of Lake Michigan, with a distinctive peak in the energy spectrum at a period of about 90 h, are simulated using a linear potential vorticity conservation model. Solutions of the forced vorticity equation in a paraboloidal basin show rotational, oscillatory motions tuned to the low-frequency topographic modes that are very similar to the observed flow patterns. Topography-controlled vorticity waves are excited most effectively by wind episodes with frequency nearly in resonance with the topographic modes. Bottom resistance has no significant effect on the frequency equation; it simply decays the waves slowly in the open lake and more quickly near the coast. Flow patterns of both the gravest free vorticity wave and the corresponding forced wave consist of two opposite circulation cells separated by a null streamline through the center of the basin and rotating cyclonically near the free wave and atmospheric forcing frequencies, respectively. Interactions between the forced and free waves result in an apparent rotational pattern with a frequency the median of the two. A combination of elliptic-paraboloidal basin and shorter period forced modes can approximate the observed Lake Michigan response. Doppler shift, due to the persistence of cyclonic vorticity in the flow field, is also determined to be a factor in shifting the elliptical basin mode to a higher frequency.

062423
INGRAM RG * **Mean and tidal circulation of the Eastmain River (James Bay)** , IN: James and Hudson Bay Symp, Scientific Studies on Hudson and James Bay, II, Guelph, Ont, April 28-30, 1981 * MARTINI IP * Nat Can * 109(4) 733-743 * 1982-12.

Measurements of current velocity, temperature and salinity were made both in the summer of 1979 and the winter-spring period of 1980 within the Eastmain River and adjacent coastal waters of James Bay. Comparison of low frequency fluctuations in the river flow and tidal current amplitude is used to determine the salinity intrusion characteristics. Contrasting hydrographic conditions in open water and under an ice cover are responsible for changes in both the offshore plume characteristics and salinity distribution in the estuary.

064070
LIE HJ, EL-SABH MI * **Formation of eddies and transverse currents in a two-layer channel of variable bottom with application to the lower St. Lawrence estuary** * J Phys Oceanogr * 13(6) 1063-1075 * 1983-06.

Baroclinic shelf waves and Kelvin waves in a two-layer channel of variable bottom are discussed using a simple numerical model. Two different propagation directions are shown to be possible, analogous to the existence of shelf waves and trench waves in an ocean bounded by a coast with a trench, described by Mysak et al. The eigenfunctions of baroclinic shelf wave modes are quite different from the barotropic eigenfunctions; that is, each of the baroclinic modes shows a pattern similar to the first mode with the exception of small scale structures near the coast. The model also shows the formation of a series of eddies with alternating rotation senses accompanied by transverse currents between two successive eddies. Eddies and transverse currents were observed in the upper layer of the lower St. Lawrence estuary based on four months of direct measurements taken in 1979. The observed wavelike motion with a period of about 80 days and a wavelength of 75 km corresponded to the fourth baroclinic shelf wave modes. The observed near-surface circulation patterns with important variability in space and time are thus explained by the superposition of two baroclinic shelf waves propagating in opposite directions.

064011
LIU PC * **A measurement of slope, curvature, and directional spectra of wind waves in Lake Michigan** , IN: Proceedings of the Seventeenth Coastal Engineering Conf, Volume 1, March 23-28, 1980, Sydney, AU * 432-443 * Am Soc Civ Eng, 345 East 47th St, New York, NY 10017 US * 1981.

Wave recording activity among coastal and

oceanic engineers has increased rapidly in recent years, and ample wave data covering a large number of gage stations are now available. Directional wave spectra, however, are relatively scarce. The detailed knowledge of directional wave characteristics that correlate with the simultaneously recorded wind field is needed immediately for a proper understanding of the generation, growth, and propagation of a wave field. The data are necessary for engineering design, for verification and improvement of wave prediction models, and for provision of appropriate ground truth for calibrating remote sensing measurements. This paper represents the results of an effort to fulfill this need.

062424
PETT RJ, ROFF JC * **Some observations and deductions concerning the deep waters of Hudson Bay** , IN: James and Hudson Bay Symp, Scientific Studies on Hudson and James Bay, II, Guelph, Ont, April 28-30, 1981 * MARTINI IP * Nat Can * 109(4) 767-774 * 1982-12.

Hudson Bay is generally believed to behave as a huge estuarine basin with fresher, less dense water flowing out at the surface and denser water moving in at depth. While surface waters have received some recent attention, comparatively little attention has been directed to the chemically and biologically important subpycnocline layer. Using both older and recent oceanographic data, we show that: the deep waters are arctic in type, circulate cyclonically, turnover approximately every 4-14 years, and are characterized by slow or incomplete regeneration of nutrients. Dissolved oxygen data from 1961, 1976 and 1978 cruises to the bay were used extensively in this analysis. Apparent oxygen utilization (AOU) calculations clearly demonstrated the long turnover time for the deep water layer, since approximately 100 g C per m(sup-2) (representing more than one year's primary production) has been catabolized below the pycnocline. Nutrient-AOU relationships also indicated that if all nitrogen were converted to nitrate by oxidative processes, then deep Hudson Bay nitrate concentrations would approach values reported for Atlantic Ocean waters. At all stations examined, the expected nitrate concentrations exceeded measured by a factor of 3 or 4 times. The initial inoculum size appears to be more important than low temperatures to nitrification reactions in offshore Hudson Bay waters, since nitrification occurs in winter in the neritic James Bay environment. Preliminary budget calculations for the whole Hudson-James Bay system indicate that nitrate and total nitrogen contributions from deep water mixing and land runoff are of the same order of magnitude, while atmospheric inputs amount to only 10% of the total.

062238
PICKETT RL, CAMPBELL JE, CLITES AH, PARTRIDGE RM * **Satellite-tracked current drifters in Lake Michigan** * J Great Lakes Res * 9(1) 106-108 * 1983.

Satellite-tracked current drifters are being used to monitor near-surface currents in Lake Michigan. These drifters are now commercially available, and preliminary tests show their satellite-determined positions to be within 0.5 km. The drifters appear to be ideal for monitoring near-surface lake currents and testing hydrodynamic lake models.

064913
PRANDLE D, FUNKE ER, CROOKSHANK NL, RENNER R * **The use of array processors for numerical modelling of tidal estuary dynamics** , IN: Proceedings of the Seventeenth Coastal Engineering Conf, Volume III, March 23-28, 1980, Sydney, AU * 2413-1432 * Am Soc Civ Eng, 345 East 47th St, New York 10017 NY US * 1981.

The use of array processors for the numerical modelling of estuarine systems is discussed in the context of "hybrid modelling". It is shown that array processors may be used to advantage in independent numerical simulations. In a hybrid model, tidal propagation in an estuary is simulated by dynamically linking an hydraulic scale model of part of the estuary to a numerical model of the remaining part so that a free interchange of flow occurs at the interface. The elevation of the water surface at the boundary of the scale model is measured and transmitted to the numerical model and the flow computed at the boundary of the numerical model is fed directly into the scale model. The use of an array processor/mini computer combination is examined to bridge the gap in computational power. A hybrid model of the Bay of Fundy is described with details of the numerical scheme presented. Various aspects relating to the use of the array processor are described, and a comparison of the performance of the array processor against that of both a mini computer and two main frame machines, is presented.

062430
PRINSENBERG SJ * **Present and future circulation and salinity in James Bay** , IN: James and Hudson Bay Symp, Scientific Studies on Hudson and James Bay, II, Guelph, April 28-30, 1981 * MARTINI IP * Nat Can * 109(4) 827-841 * 1982-12.

During the summer and winter, there exists an anticlockwise surface circulation and a weak subsurface inflow in James Bay. Model results and observations showed that surface circulation is caused partly by density differences due to runoff, and partly (in summer) by wind stress. The summer density-driven contribution has an inflow magnitude of 3.5 cm/s and an outflow magnitude of 15 cm/s which is concentrated along the Quebec shore

by the Coriolis effect. The wind stress contribution of circulation can reverse the surface outflow when a persistent southerly wind stress greater than 8 m/s occurs. Since the wind and density circulation contributions are of about equal magnitude, the total circulation will vary in strength and direction in response to the variable wind stress due to passing weather systems. In the winter, the magnitude of the surface outflow reduces to 5 cm/s and the inflow to 1.3 cm/s as a result of reduced runoff. After hydroelectric developments, the estuarine model predicts that the increase in winter runoff will cause the in- and outflow currents to double. Both the estuarine and seasonal pycnocline model predict a decrease in the winter salinity value of 1.5 per mil in the outflow surface layer at the entrance of James Bay and an increase of 0.3 per mil for the incoming water. Thus, the surface winter salinity gradients across the bay will increase as a result of the increased magnitude of the anticlockwise circulation.

062601
RAHMAN M * **Analytical solutions for tidal propagation in a rectangular basin** * Adv Water Resour * 6(1) 44-53 * 1983-03.

The tidal propagation in a rectangular basin of an estuary has been studied in this paper. The dynamic response of the tidal current and elevation inside the basin has been obtained using the concept of Kelvin waves and spectrum of Poincare waves. In this study, we have found that tidal elevations are amplified near the closed end of the basin or at the tidal barrier site.

062864
ROYER L, EMERY WJ * **Variations of the Fraser River plume and their relationship to forcing by tide, wind and discharge** * Atmos-Ocean * 20(4) 357-372 * 1982-12.

Temporal and spatial variations of the Fraser River Plume, in the central Strait of Georgia (British Columbia, Canada), are monitored by continuous salinity sampling of the engine cooling water on two B.C. ferries. Travelling along two different routes between Vancouver Island and the mainland the ferries provide eight crossings per day both north and south of the river outflow. From each crossing, characteristic measures of the plume are extracted, such as the average salinity and the maximum salinity gradient. These parameters are then formulated as time series and used to compute cross-correlations and cross-spectra with the probable driving forces of wind and river discharge. The effect of the tides is examined using harmonic analysis. Periods of high river discharge lead to decreases in the average salinity for each section, and peaks in the magnitude of the maximum salinity gradient. The correlation of the plume characteristics (average salinity, maximum salinity gradient) on the southern section with the along-strait component of the wind is consistent with advection by the wind. No obvious correlation is found between the plume characteristics on the northern section and the wind, except during isolated events. Linear combinations of the wind and the discharge variations reproduce the general trend of the average salinities but cannot explain the level of variability. A shift to a non-linear combination of wind and discharge improves this comparison. The phases of parameter fluctuations at tidal frequencies on the southern section agree with the expected effects of tidal currents and the modulation of the river discharge. The agreement is not as apparent for the northern section.

064001
SAYLOR JH, BENNETT JR, LIU PC, PICKETT RL, BOYCE F, MURTHY CR, SIMONS TJ * **Water movements** , IN: IFYGL - The International Field Year for the Great Lakes * AUBERT EJ, RICHARDS TL * 247-324 * Natl Oceanic Atmos Adm, Great Lakes Environ Res Lab, US Dep Commer, Ann Arbor, MI 48104 US * 1981-03.

Results of major projects undertaken as part of the Water Movements Program of the International Field Year for the Great Lakes, are presented. The Program included a "core" area, which was a high-density study of lake-scale water motions, in particular, circulations and internal waves, and ancillary studies, which included investigations of turbulent diffusion, surface wave phenomena and dynamic modelling. Another study, consisting of the development and verification of analytic and numerical circulation and density structure models of Lake Ontario, also formed part of the Program. Data collection techniques and instrumentation are detailed. The large-scale thermal structure of Lake Ontario including vertical transports of heat, vertical exchange coefficients, thermal structure by season and winter thermal bar and upwelling, is described. Midlake circulation in summer and winter is reviewed. Lake Ontario's response to external forcing by wind stress is discussed to illustrate whole-basin dynamics during the season of density stratification. Internal wave characteristics and models, temperature distributions and currents, and generating processes are detailed. Information on coastal currents, numerical modeling to compute water levels, currents and temperatures, focusing on principles, verification and applications, turbulent diffusion studies, and surface wave studies, is presented. Recommendations for continued research are also included.

062376
SCHERTZER WM * **How Great Lakes water moves, Chapter 3** , IN: Decisions for the Great Lakes * MISENER AD, DANILL G * 51-64 * Great Lakes Tomorrow and Prudhue Foundation * 1982.

Limnology is the study of how and why fresh water behaves as it does. Understanding the limnology of the Great Lakes is useful for a wide variety of purposes--from predicting the effects of lake storms to choosing a site for a factory, a lakeshore cottage, or a municipal sewage plant, to assessing the quality of lake water. The Laurentian Great Lakes, created in their present form by continental glaciation and by glacial erosion, comprise the largest continuous volume of fresh water on earth. The water flows east, from the headwaters at Lake Superior to the Atlantic Ocean. It passes between the lakes through various connecting channels, such as the St. Mary's River, the Strait Mackinac, and the St. Clair and Detroit Rivers, the Niagara River, and the St. Lawrence. Details of the Great Lakes Basin are given in Figure 1. A general profile of the lakes, illustrated in Figure 3-2, shows that Lakes Huron, Michigan and Ontario have comparable depths, that Lake Erie is the shallowest, and that Lake Superior is the deepest and largest. Net flow from Lake Superior to the St. Lawrence River is due to a progressive drop in elevation. Approximately seven meters (23 feet) separates Lake Superior and Lakes Michigan, Huron and Georgian Bay which are at the same level, while only two meters (6.5 feet) separates Lakes Huron and Erie. A drop of nearly 100 meters (328 feet) separates Lakes Erie and Ontario, hence the hydro-electric developments at Niagara Falls.

4.7 Diversions - Derivations

063389
Spruce River diversion project, 1982 Annual report * 22p * Inland Waters Dir, Water Surv Can, West North Reg, Water Resour Branch, Sask Dist, Environ Conserv Serv, Environ Can * 1983-06

On December 7, 1960 an agreement was signed between the Government of Canada and the Government of Saskatchewan covering the construction and operation of a dam on the outlet of Anglin Lake and a pumping plant to divert water from Anglin Lake to Emma and Christopher lakes. Anglin Lake is partially located within Prince Albert National Park thus necessitating an agreement between the two levels of government. Emma and Christopher lakes are extensively utilized for recreational purposes. This report outlines the operation of the project during 1982, with particular reference to the water levels and riparian release specified in the Agreement, provides background information leading to the development of the project, and contains a copy of the Agreement and documentation of the subsequent amendments.

063519
BOOTHROYD PN * **Effect of the Churchill River diversion on waterfowl use of the lower Churchill River in Manitoba, preliminary assessment of post-diversion conditions** * 103p * Can Wildl Serv, Winnipeg, Man * 1981-01.

The effect of reduced flows resulting from Manitoba Hydro's Churchill River diversion project on waterfowl use of the lower Churchill River was investigated in 1978 and 1979. Significant changes in river morphology were documented with aerial photography. Densities of waterfowl using areas on and away from the river in 1978 and 1979 are compared to prediversion waterfowl densities in the study area and to regional population trends. Altered flow regimes appear to have indirectly resulted in reduced use of the Churchill River by breeding ducks and geese. Low nesting effort by Canada geese was apparent on the Churchill River in 1979. It is suggested that this may be attributed to reduction in availability of attractive breeding habitat. Recommendations are made concerning further studies and regulation to Churchill River flows.

F10456
BROUARD D * **Inventaire limnobiotique sommaire du bassin de la riviere Caniapiscau en aval du lac Duplanter et perspectives d'amenagement** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

F10460
DENIS R * **Evolution geomorphologique du ruisseau Boyd (bilan provisoire)** * 6p * Les consultants SOGEAM inc * 1980-09.

Ce document se veut un bilan provisoire des premieres observations effectuees dans la region du ruisseau Boyd pour l'etude des conditions morphologiques consecutives au detournement des rivieres Eastmain et Opinaca vers le reservoir de LG 2. Apres avoir fourni une description des conditions generales du milieu physique, est abordee l'etude des facteurs de la turbidite observee et celle de l'evolution geomorphologique du ruisseau. A titre d'exemple certains profils de stations-temoins situees dans la vallee inferieure du cours d'eau a l'etude sont places en annexe.

F10594
DENIS R * **Detournement Eastmain-Opinaca-La Grande, etude de l'evolution biophysique du lit et des berges de la partie des rivieres Eastmain et Opinaca situee a l'aval des ouvrages de detournement (1980)** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

F10605
FAUBERT N * **Reconnaissance des affluents de la riviere Caniapiscau dans le troncon Duplanter-canyon Eaton** * 7p * Groupe d'etude conjoint

Caniapiscau-Koksoak, Soc energie de la Baie James, Montreal, Que * 1982-03.

Ce rapport se situe dans le cadre du programme d'etude portant sur l'evaluation des repercussions sur les elements physiques et biologiques du bassin de la riviere Caniapiscau a la suite du refoulement des eaux de ce bassin vers celui de la riviere La Grande. Il fournit les resultats d'une campagne de reconnaissance aerienne effectuee en aout 1981 et visant a observer les caracteristiques physiques (nature du lit, fosses, obstacles) et hydrologiques (epaisseur de la tranche d'eau, dynamique d'ecoulement), face aux exigence de fraie de l'omble de fontaine et de la ouananiche.

F11640
FAUBERT N, JULIEN M, LAPERLE M * **Evaluation comparative des variantes d'amenagement du secteur Eaton-Granite de la riviere Caniapiscau** * 22p * Soc energie de la Baie James, Montreal, Que * 1983-08.

La presente etude a pour objectif d'evaluer sommairement les consequences environnementales du detournement de la riviere Caniapiscau sur son troncon controle par la chute au Granite et d'analyser la faisabilite de travaux correcteurs et leur pertinence ecologique et socio-economique. Dans cette perspective, il cerne les caracteristiques physiques en tant que facteurs ecologiques qui regissent les fonctions de l'ecosysteme ainsi que sa capacite support pour les ressources biologiques. Cette etape vise a identifier les possibilites d'utilisation et/ou d'exploitation que les ressources peuvent offrir aux communautes autochtones. Les facteurs etant identifies, l'analyse des mesures correctives est faite de facon a attenuer les repercussions reelles ou a bonifier certains elements de l'environnement selon une echelle de valeur proportionnelle a l'utilisation tant actuelle que future du milieu.

F10477
INGRAM RG * **Effets du detournement de la riviere Eastmain sur l'oceanographie physique estuarienne** * 60p * Groupe interuniversitaire de recherches oceanogr du Que * 1981-12.

Ce rapport decrit le changement graduel du debit d'eau douce de la riviere Eastmain apres la diminution majeure de ce dernier en juillet 1980. Aux caracteristiques de ce debit transitoire, s'ajoute une description des conditions d'equilibre actuelles. La discussion porte sur quatre volets: 1) les caracteristiques du niveau de la maree 2) les caracteristiques de l'epanchement superficiel 3) la circulation des eaux au large et les caracteristiques de la salinite 4) les caracteristiques de la circulation sous la glace et de la salinite. En annexe, est presentee une discussion traitant des conditions estuariennes anterieures a la coupure.

066698
LAYCOCK AH * **International interbasin transfers - a current assessment** , IN: Third Biennial Plains Aquatic Research Conf, Proc, August 24 and 25, 1983, Montana State Univ, Bozeman, MT * SCOTT MD * Can Plains Proc 11 * 203-214 * Inst Nat Resour, Dep Earth Sci, Montana State Univ and Can Plains Res Cent, Univ Regina * 1983.

In the 1960s and early 1970s, a number of proposals for transfers of water from Canada to the United States were widely publicized. Most had very unfavourable features for Canada but some, with modifications, were more acceptable. The negative reactions engendered by NAWAPA especially made development unlikely but opposition within the United States was enough to put them on ice. There is still frequent reference to the earlier proposals and the growing water demand patterns in some areas are resulting in renewed interest in transfer, some of it international in potential scale. Accordingly, we should assess the current potential for such transfers and note those trends that may contribute to or deter development. These range from the state of engineering technology for such development to environmental, economic, social, and political aspects, and a wide range of conclusions may be reached.

F11648
LES CONSULTANTS SOGEAM INC * **Surveillance geomorphologique des stations-temoins sur les rivieres Caniapiscau-Koksoak suite au detournement (1982), volume 2: stations-temoins, points de repere et courbes granulometriques** * Pd * Groupe d'etude conjoint Caniapiscau-Koksoak, Soc energie de la Baie James, Montreal, Que * 1983-02.

Cette etude repond au mandat visant le suivi de l'evolution geomorphologique du systeme fluvial Caniapiscau-Koksoak apres le detournement des eaux du bassin superieur de la Caniapiscau. Elle couvre les resultats de l'etude geomorphologique realisee pendant la premiere annee suivant la reduction des debits et concerne le corridor fluvial compris entre l'ouvrage de controle Duplanter sur la riviere Caniapiscau et l'ile Koksoak sur la riviere Koksoak, soit une longueur de 490 kilometres. L'etude s'inscrit dans un programme de surveillance visant a mieux cerner la nature et l'ampleur des modifications mais aussi a valider certaines mesures de correction possibles. Les travaux comportent quatre series de releves sur le terrain distribuees dans l'annee hydrologique 1982 de facon a observer les processus dans toutes les conditions. L'etude comporte egalement la cartographie par photo-geologie des depots superficiels d'une bande de terrain d'environ 40 kilometres. Ce deuxieme volume de l'etude

renferme les informations relatives aux stations-temoins, au schema des points de repere et aux courbes granulometriques.

F11647
LES CONSULTANTS SOGEAM INC * **Surveillance geomorphologique de stations-temoins sur les rivieres Caniapiscau-Koksoak suite au detournement (1982), volume 1: textes et tableaux, documents cartographiques** * 109p * Groupe d'etude conjoint Caniapiscau-Koksoak, Soc energie de la Baie James, Montreal, Que * 1983-02.

Cette etude repond au mandat visant le suivi de l'evolution geomorphologique du systeme fluvial Caniapiscau-Koksoak apres le detournement des eaux du bassin superieur de la Caniapiscau. Elle couvre les resultats de l'etude geomorphologique realisee pendant la premiere annee suivant la reduction des debits et concerne le corridor fluvial compris entre l'ouvrage de controle Duplanter sur la riviere Caniapiscau et l'ile Koksoak sur la riviere Koksoak, soit une longueur de 490 kilometres. L'etude s'inscrit dans un programme de surveillance visant a mieux cerner la nature et l'ampleur des modifications mais aussi a valider certaines mesures de correction possibles. Les travaux comportent quatre series de releves sur le terrain distribuees dans l'annee hydrologique 1982 de facon a observer les processus dans toutes les conditions. L'etude comporte egalement la cartographie des depots superficiels d'une bande de terrain d'environ 40 kilometres. Ce premier volume de l'etude referme les observations de terrain, les resultats d'analyses et les donnees de cartographie.

064833
MCLAURIN I, SAWATZKY J * **Lake St. Joseph diversion at Root Portage, Ontario, a summary of the discharge computation procedures** * 14p * Inland Waters Dir, West North Reg, Environ Conserv Serv, Environ Can * 1983-08.

The report serves to provide an historical background to the discharge rating programs of the Lake St. Joseph control structures and the local area. It also serves as a source of all data related to the rating programs; to present the recommended curves for the outlet control structure at the west end of Lake St. Joseph as agreed to by Water Survey of Canada and Ontario Hydro; and lastly it provides an understanding of the complexities that can be involved in determining the accurate discharge through control structures.

066089
MCLEAN DG, BECKSTEAD GR * **Long term effects of a river diversion on the regime of the Milk River** , IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * v1 373-394 * Can Soc Civ Eng * (1981).

Diversion of flow from the St. Mary River into the Milk River basin commenced in 1917 and has had a pronounced effect on the receiving channel. The impact of this diversion on the morphology of the Milk River was assessed by comparing historical surveys and air photographs and analyzing available hydrologic and suspended sediment data. The major effects of the diversion included channel widening, increased cutoff activity and increased sediment yield.

065608
MONTREAL ENG CO LTD * **Bloody Creek diversion project environmental overview** * 73p * Montreal Eng Co Ltd, 5670 Spring Garden Rd, Halifax, NS * 1981-02.

This report describes the environmental implications of redevelopment of existing storage dams at Dalhousie and Corbett Lakes, and construction and operation of a pumphouse at the lower end of Dalhousie Lake to move flow over the height of land into the Paradise system. The objective of the study was to identify probable impacts associated with the redevelopment and identify any mitigating measures that could be incorporated into project construction or operation. Part II of the report describes the proposed diversion project and the relevant features of the biophysical environment within the study area. The existing environment is described in relation to natural conditions and conditions imposed by the original hydro development. In Part III of the environmental interactions associated with construction of the Bloody Creek diversion project are reviewed using an environmental matrix. The potential interactions, assuming no mitigating measures are applied, have been described in terms of minor, intermediate and major impacts. The matrix also shows where no interactions are expected. It is concluded that development of the diversion project will have a relatively small impact on the environment within the drainage area of the storage reservoirs. The previous storage dams will be increased in height by about 1 m and the surface area of the reservoirs will be increased by approximately one third. At maximum water levels, the two storage reservoirs will be joined and a canal will be constructed to allow withdrawal of water from both reservoirs over a 1.5 m drawdown. The impact of the proposed project on the reservoir areas and along the diversion is considered small. The increased size of the storage reservoirs and operation of the project are not expected to affect fish populations to a significant degree. In general, the areas affected by the storage reservoirs and the diversion flow are not productive woodland and do not appear to be important to wildlife. The major potential impact of the proposed project is associated with the reduction of stream flow in sections of Bloody Creek below the diversion. Only the lower 3.9 km of Bloody Creek is accessible to anadromous fish but an additional 6.1 km

supports populations of speckled trout. To maintain these fish populations at near current levels, maintenance flows from Dalhousie Lake of 0.06 cubic meter per second from June to October and 0.25 cubic meter per second from November to May have been requested by Fisheries and Oceans Canada.

F10473
SOC DES TRAV DE CORRECT DU COMPLEXE LA GRANDE (SOTRAC) * **Etude des effets du detournement des rivieres Eastmain et Opinaca en aval des ouvrages de derivation, rapport d'etape 1980** * 44p * Soc des trav de correct du Complexe La Grande, Montreal, Que * 1981-12.

Des 1975, le plan d'amenagement global du Complexe La Grande prevoyait le detournement des rivieres Eastmain, Opinaca et Petite Opinaca pour l'alimentation du reservoir LG 2. Differents groupes de recherche se sont vu accorder le mandat d'etudier les repercussions de la coupure des trois rivieres sur l'environnement. Au printemps 1980 un programme de surveillance des effets du detournement de ces rivieres fut mis sur pied conjointement par la Societe d'energie de la Baie James et par la Societe des travaux de correction du Complexe La Grande. Ce programme echelonne sur cinq ans, vise a suivre l'evolution biophysique des troncons de riviere situes en aval des ouvrages de detournement. Le programme vise aussi a evaluer les mesures de correction (seuils deversants, ensemencements, etc) qui seront entrepris des 1981. On trouvera dans les pages qui suivent une synthese des differentes etudes effectuees a ce jour sur les aspects physique et biologique des rivieres avant, durant et apres le detournement.

F10607
VEZINA, FORTIER ET ASSOC * **Cours inferieur de la riviere Caniapiscau rapport de validation des sites de travaux correcteurs** * 80p * Vezina, Fortier et assoc, Montreal, Que * 1982-07-15.

Suite au detournement du bassin superieur de la riviere Caniapiscau vers le bassin de drainage de La Grande riviere, les troncons de la riviere Caniapiscau situes a l'aval des ouvrages de fermeture subissent des modifications de debit tres importants. Ce rapport s'inscrit dans un programme d'etude visant a analyser les diverses possibilites d'amenagements correcteurs qui permettraient de minimiser l'impact de ce detournement et de conserver les ressources naturelles. Le but de ce rapport est de valider en fonction des repercussions du detournement sur le milieu physique uniquement, les sites les plus pertinents, ou des ouvrages correcteurs sont envisages. Ces ouvrages peuvent consister soit en l'amenagement de seuils ou soit en d'autres types de travaux. Dans ce rapport les sites sont valides en fonction du premier type de travaux seulement. Le rapport a pour but egalement de valider les sites d'amenagements de frayeres et de passes migratoires sur le cours de la riviere Caniapiscau, et une attention est portee sur les tributaires de la riviere Caniapiscau en vue de determiner si des mesures correctives sont requises a court ou a long terme.

4.8 Estuaries and Deltas - Estuaires et deltas

F10475
ANGLEJAN B * **Etudes sedimentologiques dans l'estuaire de la riviere Eastmain en 1980 et 1981** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

066404
BIRTWELL IK, GREER GL, NASSICHUK MD, ROGERS IH * **Studies on the impact of municipal sewage discharged onto an intertidal area within the Fraser River estuary, British Columbia** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

065906
BUCKLEY DE, WINTERS GV * **Geochemical transport through the Miramichi Estuary** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

F12063
CATALIOTTI-VALDINA D, LONG BF * **Evolution estuarienne d'une riviere regularisee en climat sub-boreal: la riviere aux Outardes (cote nord du golfe du St-Laurent, Quebec)** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

F11188
CATALIOTTI-VALDINA D, LONG BF * **Evolution du debit liquide et de la charge solide d'un estuaire sub-boreal: riviere St-Jean, Quebec (cote nord du golfe du St-Laurent)** * J can sci terre * 20(2) 184-194 * 1983-02.

L'hydrodynamique de l'estuaire de la riviere St-Jean et en particulier la dynamique des ecoulements a ete determinee ainsi que les mecanismes de melange eau fluviale - eau marine. Dans ce but, deux campagnes de mesures de decharge liquide et solide ont ete menees, la premiere au cours d'une crue printanniere (mai 1980), la seconde en etiage de vive-eau (aout 1980). En periode de crue, le debit fluvial moyen est de 1035 m cubique/s et en etiage de 85 m cubique/s. Pour les debits fluviaux superieurs a 160 m cubique/s, le coin sale est rejete hors de l'estuaire et il n'y a pas de renverse de courants dans l'estuaire, seulement une attenuation des vitesses de courant a l'embouchure. Les concentrations de matiere en suspension

varient de 96 mg/L en periode de crue (65-95% de matiere minerale) a 4,6 mg/L en periode d'etiage (58% de matiere minerale). Le comportement general de l'estuaire de la riviere St-Jean permet d'envisager l'existence d'un nouveau type d'environnement: les estuaires sub-boreaux. Ils se caracterisent par un rapport Qm/Qf proche de celui des estuaires hautement stratifies mais le regime des materiaux en suspension ne correspond ni a celui des estuaires micro- ou mesotidaux de la Nouvelle Angleterre ni a celui des estuaires macrotidaux de l'ouest Europeen.

063667
CHAPMAN PM * **Measurement of the short-term stability of interstitial salinities in subtidal estuarine sediments** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

059132
CHURCHLAND LM * **Fraser River estuary study water quality, microbial water quality, 1970-1977** (see 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

F10445
COUILLARD D * **Geologie et geochimie du fleuve, de l'estuaire et du golfe Saint-Laurent (Canada)** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

065707
COUTURE R, SINCLAIR M * **Summer distribution of particulate organic matter in a salt-marsh estuary on the Northumberland Strait** (see chapter 4.9 for complete reference - voir chapitre 4.9 pour la reference complete)

064579
DABORN GR, REDDEN AM, GREGORY RS * **Ecological studies of the Annapolis Estuary, 1981 - 82** * Acadia Univ Inst (Rep) No 29 * 80p * Acadia Univ Inst, Wolfville, NS * 1982-08.

Although extensive surveys of soils, surficial geology and marshland elevations were carried out before the construction of the Annapolis Tidal Dam, no reviewed environmental impact studies of the Estuary were completed. The present studies were initiated to compensate for obvious omissions. The Annapolis Tidal Power Project provides an opportunity to examine some aspects of the operation of a tidal power station and its environmental impact, that are relevant to the much larger development in Minas Basin now under consideration. Construction of the Annapolis Tidal Dam in 1960 resulted in conversion of the pre-existing vertically homogeneous estuary into a two-layered salt-wedge type estuary. The stability of this stratification is highly variable, and is an important ecological feature. Vertical profiles of salinity, conductivity and temperature were obtained at 18 stations, and Secchi Disc depth was recorded. Phytoplankton and zooplankton samples were obtained and analyzed. Benthic samples were taken at 148 sites, chosen on a stratified random basis, in June, July, and August, 1981. The studies outlined in this report represent the first systematic and comprehensive investigations of non-vertebrate fauna of the Annapolis Estuary. Much analysis of the data needs to be carried out, for the environmental impact assessment of the Annapolis Tidal Power Project. The results are limited in that they represent only a few months in a given year. The present studies have demonstrated that biological and physico-chemical features of the Annapolis Estuary are influenced most strongly by the degree of water column mixing.

063466
DICKIE LM, TRITES RW * **The Gulf of St. Lawrence, Chapter 16** (see chapter 4.5 for complete reference - voir chapitre 4.5 pour la reference complete)

063774
DORCEY AHJ * **Strategies for coastal resource management in western Canada - while battles are being won, is the war being lost?, Chapter 14** (see chapter 4.10 for complete reference - voir chapitre 4.10 pour la reference complete)

064473
DORCEY AHJ, HALL KJ * **Setting ecological research priorities for management: the art of the impossible in the Fraser Estuary** * 90p * Univ British Columbia, Westwater Res Cent, Vancouver, BC * 1981.

The results of a case study research of estuary management on the Fraser River Estuary are reported. An analysis of how policies and institutional arrangements for coastal resources management may be strengthened, is given. The relationship between management and research, prediction of water quality conditions and biological productivity, and priorities for developing new management information are discussed.

F10476
DUPUIS P, OUELLET Y * **Regime hydrodynamique de l'estuaire de la riviere Eastmain** * 153p * Groupe interuniversitaire de recherches oceanogr du Que * 1981-12.

La modification du regime hydrologique de la riviere Eastmain apporte par le detournement de son bassin superieur aux fins de remplissage du reservoir amont de la centrale LG 2 sur la riviere La Grande, a un impact sur la propagation de la maree ainsi

que sur le regime de salinite au niveau de l'estuaire. Ces modifications du milieu physique entrainent subsequemment une repercussion au niveau de l'environnement, plus particulierement de l'escosysteme estuarien. La presente etude par modele mathematique vise a identifier les consequences de la variation de l'apport d'eau douce sur le regime estuarien de la riviere Eastmain; les resultats obtenus servent de donnees de base pour les ecologistes en vue d'etudes d'impact sur la faune et la flore locale. L'etude porte sur deux periodes, a savoir les periodes pre et post-coupure correspondant respectivement aux campagnes de mesure des etes 1980 et 1981.

066376
GEARING JN, GEARING PJ * **Suspended load and solubility affect sedimentation of petroleum hydrocarbons in controlled estuarine ecosystems** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

F10477
INGRAM RG * **Effets du detournement de la riviere Eastmain sur l'oceanographie physique estuarienne** (see chapter 4.7 for complete reference - voir chapitre 4.7 pour la reference complete)

065908
LANGSTON WJ * **The behavior of arsenic in selected United Kingdom estuaries** . IN: Conf on Pollution in the North Atlantic Ocean, Halifax, NS, Oct 19-23, 1981 * Can J Fish Aquat Sci * 40(suppl 2) 143-150 * 1983.

High As concentrations occur in certain United Kingdom estuaries as a result of mineralization and associated processes including mining and metal refining. Analyses of dissolved and particulate As, carried out in estuaries of differing contamination, indicate that As is readily precipitated with Fe during mixing at the freshwater--seawater interface. This gives rise to significant correlations between the two elements in suspended and bottom sediments. More than 80% of the As entering Restronguet Creek, the most contaminated of the estuaries studied, is retained by estuarine sediments, which consequently act as sinks for riverine inputs and limit transport of dissolved species to coastal waters. However, the behavior of As in different estuaries varies with the physicochemical conditions present and the nature of the source. Most significantly, remobilization of sediments is recognized as a feature affecting the cycling of As in the Tamar Estuary.

066380
LEE RF, RYAN C * **Microbial and photochemical degradation of polycyclic aromatic hydrocarbons in estuarine waters and sediment** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

064070
LIE HJ, EL-SABH MI * **Formation of eddies and transverse currents in a two-layer channel of variable bottom with application to the lower St. Lawrence estuary** (see chapter 4.6 for complete reference - voir chapitre 4.6 pour la reference complete)

062753
LONG BF * **Evolution of Outardes Estuary after the hydraulic power regulation** (see chapter 4.5 for complete reference - voir chapitre 4.5 pour la reference complete)

066535
LUCOTTE M, D'ANGLEJAN B * **Forms of phosphorus and phosphorus-iron relationships in the suspended matter of the St Lawrence Estuary** (see chapter 4.16.1 for complete reference -voir chapitre 4.16.1 pour la reference complete)

066632
LUTERNAUER JL, LIAM FINN WD * **Stability of the Fraser River Delta front** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

064913
PRANDLE D, FUNKE ER, CROOKSHANK NL, RENNER R * **The use of array processors for numerical modelling of tidal estuary dynamics** (see chapter 4.6 for complete reference - voir chapitre 4.6 pour la reference complete)

067179
RAY S, MACKNIGHT SD * **Trace metal association with suspended particulate matter due to dredging of Miramichi estuary, N.B., Canada** . IN: Int Conf Heavy Metals in the Environment, Heidelberg, September 1983 * Mueller G (chairman) * 976-979 * CEP Consult Ltd, 26 Albany St, Edinburgh EH1 3QH GB * 1983.

Cu, Zn, Cd, Pb, Fe and Mn concentrations in sediment and suspended particulate matter (SPM) of the Miramichi estuary were monitored prior to and during dredging. The observed variation in metal concentrations of sediment and SPM prior to dredging could be attributed to the physicochemical environment of the estuary. Wide variation in natural levels of the metals effectively masked any subsequent change due to dredging.

062758
TARBOTTON MR, PEDERSEN AE, BIRT CS * **An engineering investigation of the estuary of the Senegal River** . IN: Proc Canadian Coastal Conf 1983, Vancouver, 11-14 May 1983 * HOLDEN BJ * 55-71 * Natl Res Counc, Assoc Comm Res Shoreline Erosion Sediment, Ottawa, Ont K1A OR6 * 1983.

The "Organisation pour la Mise en Valeur du Fleuve Senegal", (O.M.V.S.), an organization sponsored by the Republics of Mali, Mauritania and Senegal, is planning the construction of a new deepsea port at Saint-Louis on the Atlantic coast of Senegal. The port, to be located at the mouth of the Senegal River, is part of a much larger river basin development. The Canadian International Development Agency, which is assisting the O.M.V.S., has appointed the Canadian consulting firms of Beauchemin, Beaton, Lapointe and Swan Wooster Engineering to plan the development of the new port. The design is being preceded by a year long program of data gathering on the open coast and in the river estuary. This paper describes the field investigation performed in the estuary and discusses the degree of success experienced with the methods employed. Computer simulations of the estuary dynamics are presented and compared with the measured data. In addition, the measured stratification of the estuary is discussed. In conclusion, the paper points to possible future conditions in the estuary after construction of a new deep navigational channel.

065920
TOWNSEND GH * **An evaluation of the effectiveness of the Rochers Weir in restoring water levels in the Peace-Athabasca Delta** * 47p * Environ Can, Can Wildl Serv, Saskatoon, Sask * 1982-01.

In December 1978, the Canadian Wildlife Service accepted a request from Parks Canada to evaluate the monitoring studies that were conducted on the Peace-Athabasca Delta after the Delta Project studies were terminated in 1973. A major part of this evaluation, and the purpose of this paper, is to assess the effectiveness of two weirs in restoring water levels on the Delta and Lake Athabasca. The report compares pre-Bennett Dam flows, lake levels and predicted regimes with four years of recorded operation since construction of the remedial weirs. It concludes that the weirs have raised minimum winter Lake Athabasca levels but have not increased the maximum summer levels to the extent to periodically recharge the perched basins within the Delta. Because of this, many of the environmental and economic consequences identified with the future operation of the Bennett Dam can be expected to continue. Therefore, additional steps now seem necessary to achieve the commitments made ten years ago by the three governments to restore the Peace-Athabasca Delta.

F10593
VERRETTE JL, FRENETTE M * **Riviere Eastmain, analyse du comportement morphologique de l'estuaire** * 43p * La Soc des trav de correct du complexe La Grande, Montreal, Que * 1981-01.

Cette etude a pour objectif d'effectuer l'inventaire et la synthese des informations disponibles sur les problemes de sedimentation de l'estuaire de la riviere Eastmain, de consulter la population cris du village d'Eastmain en relation avec ses preoccupations face aux conditions de navigabilite dans l'estuaire, et de produire un programme de mesures (bathymetrie, maree, debit fluvial, etc) comme complement aux informations manquantes.

4.9 Wetlands - Terres humides

062390
ARAFAT NM, GLOOSCHENKO WA * **The use of bog vegetation as an indicator of atmospheric deposition of arsenic in northern Ontario** * Environ Pollut Ser B * v4 85-90 * Ripple Road, Barking, Essex, GB * 1982.

There is ample evidence of the release of potentially toxic metals from the Sudbury region of Ontario. However, insufficient information is available concerning the distribution of arsenic from atmospheric inputs in northern Ontario. This element is associated with smelting activities in other parts of Canada, especially northern Manitoba and Yellowknife, NWT. Bog vegetation was chosen as an indicator of this chemical input, since bogs receive their chemical inputs solely from atmospheric fallout. This alleviates problems associated with monitoring lake sediments and soils which can receive elemental inputs from their watersheds. An increase in As concentration was found in bog vegetation near smelters, both at Sudbury and in the Timmins/Kirkland Lake, Ontario/Rouyn, Quebec areas. A distinct decrease in concentration occurred with distance. A comparison of As levels between species examined at the same location indicated that the moss and lichen species were more efficient scavengers of As than low shrubs. Concentrations determined in this study were above background data from more remote areas, especially in the Sudbury area where a 20 x increase was noted in lichens. This study further confirms the use of bog vegetation as a sensitive indicator of elemental fallout.

066472
BEETS ML * **A wetland classification system that just might work!** . IN: Land/Wildlife Integration No. 2, Proceedings of a technical workshop to discuss the incorporation of wildlife information into ecological land surveys, 21-24 March 1982, Banff, Alta *

STELFOX HA, IRONSIDE GR (comp) * Ecol Land Classif Ser No 17 * 29-35 * Environ Can, Lands Dir, Ottawa, Ont K1A 0E7 * (1982).

In 1978, a committee was formed by the B.C. Wetland Working Group to write a report on interior (Cariboo Region) wetlands. The report discussed problems involving user requirements of wetlands and proposed the basis for a wetland classification system. Two well respected consultants were hired to develop a wetland classification system for the Cariboo Region, using the recommendations and guidelines of the regional committee. The classification system has been field tested, accepted by resource agencies in the Cariboo Region and published in the "Preliminary Wetland Managers Manual - Cariboo Resource Management Region." The classification system is simple to understand, easy to use and based on an ecological classification system that is not biased towards any one use. The paper discusses the classification system and how it evolved.

063189
CECILE CP * **Summary report on the environmental studies at Second Marsh, Draft** * 112p * 1980-11.

This report describes the biological aspects of Second Marsh that were investigated during the summer of 1980. The study methods used are outlined and a description is given of the study area, including the vegetation, fish and wildlife. Currently, Second Marsh consists of an open, shallow body of water ringed by stands of cattails, wet graminoid meadows, willow shrub thickets and wet poplar-ash woodlands. Preliminary results of the Point-Quarter sampling of the northern woodlands are expressed as relative density of trees forming a stand, relative dominance of each species in that stand and relative frequency of each species occurring throughout the stand. These three variables are then combined to produce an "importance value" for each species, providing a means for some comparison and description. These results are presented in a table. Reptiles and amphibians in the marsh are represented by several species of turtles, snakes and frogs which are listed in the appendices. Large and small mammals observed in the marsh are also listed, with the muskrat being the most dominant of the large mammals present. Birds continue to be the most significant wildlife feature of Second Marsh. A list of birds observed during the summer is contained in the appendices along with a complete species list of birds observed in the marsh over the last 40 years. As preliminary indications suggest, the quality of wildlife habitat at Second Marsh has been deteriorating over the last 50 years, some form of mitigation and/or active management will be required to halt further degradation of the Second Marsh ecosystem and to fully develop the habitat potential of the marsh. A preliminary checklist of vascular plants of the Second Marsh Study Area is contained in an appendix.

066610
CECILE CP * **Oshawa Second Marsh baseline study, Final report, Documentation, integration, and interpretation of ecological data** * 158p * Environ Can * 1983-03.

Environmental studies by Environment Canada under the federal baseline studies programme were initiated as a result of increased public interest and concern in Oshawa Second Marsh. These studies provide the necessary information base to facilitate the management of the marsh in an environmentally sound manner. The 117 hectare Second Marsh study area located within the City of Oshawa, includes a lakeside marsh and woodland. Components studies included watershed erosion and sediment transport, marsh soil and sediment quality and quantity, water quality and quantity, shoreline processes, vegetation, and wildlife. Very high loads of sediment eroded from the watershed are being deposited in the marsh. The bottom sediments are contaminated with heavy metals such as nickel and zinc. Water quality has been improving. While Second Marsh historically was an important migratory waterfowl staging area, it currently supports a much reduced duck population. The marsh still hosts a high diversity of migrating and breeding birds. Impacts and changes sustained by the marsh include a high rate of sediment deposition, increased pollutant loading, isolation of the marsh from other natural areas, and large numbers of disruptive carp. In addition, dyking of the previous western outlet resulted in the formation of the eastern outlet which led to other changes in the marsh. Sedimentation within Second Marsh is currently the most serious threat to its existence and value as a wildlife habitat.

063185
CHAMBERLAIN DA * **An evaluation and comparison of Dover Marsh (Lake St. Clair), four Lake Ontario marshes and Goose Bay Marsh (Sturgeon Lake)** * 76p * Can Wildl Serv, Ont Reg * 1980-12.

This report evaluates four Lake Ontario marshes: Cranberry Marsh, Camp X Marsh, Second Marsh and Duffin Creek Marsh as well as Goose Bay Marsh (Sturgeon Lake) and Dover Marsh (Lake St. Clair National Wildlife Area) on Lake St. Clair. Cover type maps were produced for all of the wetlands and photographic records were made of Second Marsh, Camp X Marsh and Cranberry Marsh. Aerial photograph and topographical maps were obtained for use in the field studies. For the evaluation of individual wetlands, the scoring system set out by Reid, et al (1980) was followed and evaluation summary sheets were completed. Each of the wetlands is described in detail and vegetation communities

and birds present in each area are listed. An evaluation of the wetlands is presented with a discussion of biological function values, hydrological function values, cultural function values, and management requirement values. The actual values placed on the different parameters for each marsh are shown in tables. Of the seven marshes evaluated, Cranberry Marsh ranked first in biological value while Second Marsh ranked second. Goose Bay Marsh exhibited the greatest value hydrologically and the greatest cultural value was shown by Dover Marsh with Second Marsh ranking second. Second Marsh and Goose Bay Marsh both exhibited the highest management requirement values. Only Second Marsh consistently ranked high in value.

065707
COUTURE R, SINCLAIR M * **Summer distribution of particulate organic matter in a salt-marsh estuary on the Northumberland Strait** * Proc Nova Scotian Inst Sci * 32(4) 297-312 * Nova Scotian Inst Sci, Halifax, NS * 1982.

The summer distribution of particulate organic matter and relevant hydrographic characteristics are described in Merigomish Harbour, a salt-marsh estuary on the Northumberland Strait. The estuary is characterized by low phytoplankton biomass relative to similar estuaries in eastern United States. This is interpreted to be due to the low nutrient concentration in the source of the bottom water. Short-term fluctuations in stratification, surface nutrients, turbidity, and phytoplankton biomass appear to be controlled by short-term fluctuations in freshwater runoff. This control of short-term variability in estuarine characteristics by freshwater runoff may be characteristic of estuaries associated with small drainage basins. The particulate organic matter is dominated by detritus which is interpreted to be the degradation product of species of Spartina. Given the short residence time of the estuary and the high seston concentrations, Merigomish Harbour and similar estuaries along the western Gulf of St. Lawrence are significant sources of particulate organic matter to the coastal zone of the Gulf of St. Lawrence.

067162
COWELL DW, WICKWARE GM, JEGLUM JK, SIMS RA, BOISSONNEAU AN * **Hudson Bay lowland peatland inventory** , IN: Proc Peatland Inventory Methodol Workshop, 9-10 Mar 1982, Ottawa, Ont * MORGAN SM, POLLETT FC * 88-102 * Agric Can, Land Resour Res Inst, and Environ Can, Nfld For Res Cent * 1983.

In 1976 a program of ecological studies in the HBL was initiated by Environment Canada. This paper summarizes the inventory information available on wetland and peatland types and on the peat resources in the HBL. The wetlands have been classified on the basis of vegetational physiognomy. This approach was found useful for integrating other soil and site information. In the Ontario HBL the coastal, arctic tundra and subarctic vegetation units occupy 28.1% of the area; upland forests, rich swamps and white spruce 2.4%; fens and water 13.5% and the remaining 54.1% consists of muskeg and bog types. The mapping of wetland ecosystem patterns using Landsat imagery has been undertaken by the Ontario Centre of Remote Sensing. The best form of Landsat data is the computer compatible type (CCT). The maps produced can be used for integrated investigations of peatlands. Also the same peatland ecosystem types identified on the maps could provide the basis for stratification of sampling for any number of biotic and abiotic conditions.

060469
ENVIRON CAN, ONT REG * **Oshawa Second Marsh baseline study, Interim report summary** * 8p * Environ Can, Ont Reg, 55 St Clair Ave East, 7th Floor, Toronto, Ont M4T 1M2 * 1982.

A summary is presented of an interim report which documents the various components of the Second Marsh Baseline Study and interprets and integrates these findings with historic data to determine the current ecological status of the marsh. Second Marsh is located on the North Shore of Lake Ontario within the City of Oshawa. Historical aspects of its ecosystem are presented. The current high sedimentation rates have accelerated the filling in of the marsh to a point where the marsh averages only half a meter in water depth with a central area of exposed mud flats. If the high rates of sedimentation continue, a loss of open water areas in the marsh will likely result, making the marsh less valuable to ducks and other wildlife. Vegetation of Second Marsh is a diverse assemblage of plant communities. The marsh possesses excellent habitat and potential habitat for many species of wildlife. Its variety of plant communities and abundance of food plants makes it attractive to many species of birds including migrating waterfowl. Muskrats are the most obvious of mammals which occur at Second Marsh. Very few amphibians and reptiles currently occur, however the marsh is considered to be an important spawning and nursery area for at least 12 species of forage fish. Changes in the environment of Second Marsh since the early 19th century have generally resulted in the deterioration of wildlife habitat within the marsh and clearing of the forests resulted in excessive erosion which led to sedimentation and increased eutrophication in the marsh. Urbanization has increased pollutant loading to Second Marsh. The water quality of Farewell and Harmony Creeks, though currently not seriously impaired, does affect the marsh ecosystem. Pollutants and contaminants from sewage treatment plants, sea lamprey control programs and upstream urban areas may not only singly

affect the marsh but also may have synergistic or cumulative negative effects on the biota of Second Marsh.

066479
FLORY PM, SCHMIDT AP * **Mapping of critical terrestrial wildlife habitat and wetland habitat in selected portions of agricultural Saskatchewan** . IN: Land/Wildlife Integration No. 2, Proceedings of a technical workshop to discuss the incorporation of wildlife information into ecological land surveys, 21-24 March 1982, Banff, Alta * STELFOX HA, IRONSIDE GR (comp) * Ecol Land Classif Ser No 17 * 87-90 * Environ Can, Lands Dir, Ottawa, Ont K1A OE7 * (1982).

Both a Terrestrial Wildlife Habitat Inventory and a Wetland Habitat Inventory have been completed for some portions of agricultural Saskatchewan. The former includes a report and maps illustrating land systems, land use, land tenure, and critical wildlife habitat, while the latter contains a report and maps of relative densities of small wetlands, human influences, and key wetland habitat. The primary objective of the inventories, to identify and quantify critical habitat with its preservation and management in mind, has been fulfilled. In addition, these inventories have had extensive use in preparation of the Department of Tourism and Renewable Resources' strategies for the supply and use of wildlife for the 1980's. The objectives and goals for the Wildlife Branch in the 1980's are based to a large degree on the information contained in the Terrestrial Habitat Inventory.

065427
GOODMAN AS * **Habitat conservation in northern Canada** . IN: First western hemisphere waterfowl and waterbird symposium, Proc Int Waterfowl Res Bur Symp, Edmonton, Alta, 25-28 May 1982 * BOYD H * 51-53 * Can Wildl Serv, Ottawa, Ont K1A OE7 * 1983.

Human activities producing appreciable changes in wetlands and waterfowl habitat north of 60 degrees N were few and insignificant until 20 years ago. Exploration for oil, gas, and minerals has resulted in major finds that are being exploited at a rapidly accelerating rate. Methods of preventing or minimizing damage to key waterfowl areas are described. Encouragement of non-renewable resource development and control of land use are in the hands of the Department of Indian and Northern Affairs and the governments of the Northwest Territories and the Yukon. Those agencies, and the industrial interests they represent, have offered strong resistance to the creation, under the management of the federal Department of the Environment, of national parks, national wildlife areas, and migratory bird sanctuaries, in which wildlife values would be given highest priority. Successes in minimizing damage to key wetland areas have been registered by working with the agencies regulating land use. Though less satisfactory and dramatic than direct management for wildlife, influencing the content and monitoring the effectiveness of land-use regulations is an important method of wildlife habitat conservation.

061870
JASIENIUK MA, JOHNSON EA * **Peatland vegetation organization and dynamics in the western subarctic, Northwest Territories, Canada** * Can J Bot * 60(12) 2581-2593 * 1982-12.

Species frequency abundance was determined in 77 peatland stands and the variance partitioned between the effects of fire and habitat. Each variance partition was then analyzed using principal component analysis. The resulting habitat ordination was interpreted in terms of a moisture-nutrient gradient and a sphagnum substrate gradient. The fire frequency ordination gave a gradient of plant adaptations to the interval between fires. Vegetation change after fire is predominantly change in species abundance. It consists of a regeneration to the predisturbance species composition which depends on the moisture-nutrient and sphagnum substrate conditions. Changes in species composition are suggested to be due to major changes in habitat characteristics usually the result of water level fluctuations. A discussion of the frequency of disturbance due to water level fluctuations and fire for different peatland communities is presented.

062260
KADLEC JA * **Water budgets for small diked marshes** * Water Resour Bull * 19(2) 223-229 * Am Water Resour Assoc, 5410 Grosvenor Lane, Suite 220, Bethesda, MD 20814 US * 1983-04.

This paper reports an analysis of the water budgets of 10 small (5-6 ha) diked areas (cells) within the Delta Marsh in southcentral Manitoba, Canada. The important terms in the water budget equation in this study were precipitation (P), water pumped in (SWI), evapotranspiration (ET), seepage in (GWI) and out (GWO), and change in storage (delta S). P, SWI, and S were measured directly, and the sum of ET and GWO determined by difference. Estimating ET as 0.7 pan evaporation gave a seepage loss of 2.9 mm/day from the most intensively studied cell. Other methods of estimating ET produced estimates of GWO ranging from 2.4 to 3.8 mm/day. Water budgets for less intensively studied cells indicated seepage loss increased as perimeter available for seepage increased, but not proportionately. Efforts to measure seepage directly or estimate it from measured hydraulic gradients and hydraulic conductivity produced estimates much lower than the estimates from the water budget equation. Hydraulic conductivities were very

heterogeneous, reflecting the sorting of water deposited sediments. Comparison of the hydraulic conductivities with seepage estimates from the water budget strongly suggests water movement downward as well as laterally from these diked areas.

066557
LYNCH-STEWART P * **Land use change on wetlands in southern Canada: review and bibliography** * Work Pap No 26 * 115p * Lands Dir, Environ Can * 1983-04.

The study of wetlands from a land use change perspective has been selected as the second component of the Prime Resource Lands Project, Canada Land Use Monitoring Program. This report examines the existing information on wetland conversion, to serve as a basis for the design and focus of a national land use monitoring project. The report consists of four major sections. A literature review summarizes the nature and scope of existing information sources and identifies major data gaps. A national overview examines the conversion of wetlands to agricultural use, urban and industrial development, energy-related development and recreational use. A geographical breakdown of nationally and regionally-significant issues is provided for each land use type. The final sections present a summary and conclusions related to wetlands conversion across southern Canada with general recommendations. Detailed descriptions of the quantitative data bases identified, and brief annotations of the qualitative sources, are appended to the report.

064220
MAYHOOD DW * **Chemical and biological monitoring of Muskeg drainage at the Alsands project site, Program evaluation and suggestions for continued monitoring (Draft)** * 25p * Aquat Environ Ltd, Calgary, Alta * 1982-09.

This report evaluates the 1980 Alsands monitoring program and makes suggestions for the conduct of future monitoring studies on the Muskeg River and elsewhere in the AOSERP area. It assesses the effectiveness of the ditch and outfall designs in limiting the suspended solids load contributed to the Muskeg River and discusses possible mitigative measures based on the findings of the present monitoring program. It evaluates the usefulness and suitability of the parameters chosen for monitoring in the current program.

066603
MAYHOOD DW, CORKUM LD * **Chemical and biological monitoring of muskeg drainage at the Alsands project site, Volume I, Review of available data on the Muskeg River, Draft** * Alberta Environ, Res Manage Div * 77p * Alberta Environ, Edmonton, Alta * 1981-04.

The available literature on the Muskeg River and its tributaries was critically reviewed as a background for monitoring studies conducted on the river in 1980. The review indicated that the literature provides a basic description of the ecology of selected streams within the Muskeg River basin. The description, particularly the water quality and periphyton portions, suffers from certain inconsistencies in the data both within and among studies, and from unresolved disagreements in interpretation among investigators. Baseline data available on hydrology, benthic invertebrates, plankton and fish are generally useful, but additional information is desireable on streamflow near the Alsands site, the benthic fauna of soft substrates (particularly chironomids), specific areas of critical habitat for fish, and the numbers of Arctic grayling using the river.

064222
MAYHOOD DW, WALDER GL, DICKSON T, GREEN RB, REID DE, STUSHNOFF R * **Chemical and biological monitoring of Muskeg drainage at the Alsands project site, Volume II, Monitoring and fish studies** * 247p * Alta Environ, Edmonton, Alta and Alsands Energy Ltd, Calgary * 1981-09.

Volume I of this report reviewed the publicly available literature on stream environments in the Muskeg River Basin as background to the monitoring studies. This volume describes the results of the monitoring studies, discusses their effectiveness, and makes suggestions about the design of similar monitoring programs that might be established in the future in the AOSERP area. Biological and water quality attributes were studied within the zones of potential impact and in control areas. Measures of water quality, such as suspended solids, dissolved oxygen, major ion, metal and nutrient concentrations were studied to obtain direct information on physical and chemical impacts at the time of sampling. Periphytic algae and benthic macroinvertebrates were sampled by several methods to detect the biological effects of physical and chemical changes in water quality. Biological monitoring had the potential of detecting impacts that occurred prior to sampling, and provided a direct measure of biological damage. A fish sampling program was conducted in conjunction with the monitoring studies to supplement available life history information on species inhabiting the Muskeg River. This report presents the methods that were used to carry out these studies, the results of the field observations, and the conclusions that were reached.

067164
MOON DE, SELBY CJ * **Wetland systems of the Cariboo-Chilcotin region of B.C.** , IN: Proc Peatland Inventory Methodol Workshop, 9-10 Mar

1982, Ottawa, Ont * MORGAN SM, POLLETT FC * 54-74 * Agric Can, Land Resour Res Inst, and Environ Can, Nfld For Res Cent * 1983.

The concept of a wetland system is developed. A wetland system defines the relationship between wetland classes that occur as contiguous units within a single wetland area. Nine wetland systems are defined for the Cariboo-Chilcotin region of British Columbia. Descriptions, accessory and diagnostic characteristics are presented for both the systems and wetland components (classes) which make up the systems. Map units and map symbols are defined and correlation with the National Wetlands Registry is provided. Classification procedures and considerations and constraints for computer assisted classification are briefly discussed.

066561
MOONEY MB * **Classifying visual attributes of wetlands in the St. Lawrence - eastern Ontario region** . IN: The future of wetlands, assessing visual-cultural views * SMARDON RC * 99-117 * Allanheld, Osmun & Co Publ, Inc, 81 Adams Drive, Totowa, NJ 07512 * 1983.

The physical attributes of wetlands found to be important to visual values are water bodies, landform, surrounding land use, and wetland vegetation. The key visual attributes identified are visual contrast and visual diversity of the wetland and its surroundings. The following objectives were established based on previous assumptions: to clearly and systematically identify and describe visual attributes important to wetlands and their surrounding landscape context; to adapt and test a method of visual description in selected areas within the St. Lawrence-Eastern Ontario region; to ensure that the descriptive classification has utility to planners and designers so that the visual attributes of wetlands can be protected. Three study areas were selected along the shoreline of Jefferson County, New York: Sandy Creek, Black River Bay and Goose Bay. The information from visual assessment could be used by private firms and governmental agencies for environmental-impact statements that involve visual values of wetlands.

067159
MORGAN SM, POLLETT FC (ED) * **Proceedings of a Peatland Inventory Methodology Workshop, March 9 and 10, 1982, Ottawa, Ontario** * 121p * Agric Can, Land Resour Res Inst, and Environ Can, Nfld For Res Cent * 1983.

The Peat Forum, a nucleus of peat expertise from several federal agencies, was established to advise on and facilitate coordination of National Research Council's Peat for Energy and Chemicals Program. This workshop is a result of discussions within the Peat Forum, whose members saw a great need to clarify and bring into focus the activities across Canada associated with peat and peatland resource assessments. The workshop was intended to establish clear directions for the methodology of peat inventory. It is hoped that eventually standard procedures and tests will evolve to allow accurate national assessments of the peat resources. Papers were given on peatland inventory in Minnesota, Newfoundland, Manitoba, Ontario, the Caribou-Chilcotin region of British Columbia, New Brunswick, the Hudson Bay lowland, Quebec, and Labrador. Other papers were on ecology studies, mapping of peat deposits, and wetland land use monitoring.

F10217
MUDROCH A * **Etude de certains marais cotiers selectionnes des Grands lacs** * Etude no 122, Ser sci * 46p * Environ Can, Inst natl rech eaux, Dir gen eaux inter, Burlington, Ont * 1981.

Les effets positifs et negatifs de six marais attenants aux Grands lacs sur la qualite des eaux de ces derniers ont ete etudies. On a examine les variations dans les concentrations en matieres nutritives (N et P) et en oligo-elements (Pb, Cu, Cr, Ni, Cd, As et Hg) de l'eau des marais, la geochimie des sediments et l'assimilation des matieres nutritives et oligo-elements par les plantes des marais, ainsi que la production de leur biomasse. La concentration en matieres nutritives et en oligo-elements des eaux et des sediments des marais a ete comparee a celle des lacs Ontario et Erie. Les concentrations en diverses formes d'azote differaient beaucoup entre les marais et les lacs et les cours d'eau.

066083
MUZIK I * **Muskeg drainage** . IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * v1 197-217 * Can Soc Civ Eng * (1981).

Development of a lignite deposit at Onakawana in north-eastern Ontario requires extensive drainage of muskeg blanketing the proposed mine area. Dewatering of the muskeg is necessary prior to its stripping. Muskeg drainage systems must also handle efficiently surface runoff due to rainfall and snowmelt. Hydrologic analysis of the muskeg and hydrologic design of the muskeg drainage system are presented. Surface runoff quantities were estimated by means of rational method and a kinematic wave model of overland flow. Modified Glover-Dumm equation was used to calculate ditch spacing required for muskeg dewatering. Preliminary drainage system layout is discussed.

063489
PERCY KE * **Heavy metal and sulphur concentrations in Sphagnum magellanicum Brid. in the Maritime Provinces, Canada** * Water Air

Soil Pollut * 19(4) 341-349 * 1983-05.

A regional survey of selected heavy metals and S concentrations in Sphagnum magellanicum Brid. was completed within the Maritime Provinces, Canada. The concentrations of Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Pb, S, and Zn were used to describe regional atmospheric deposition patterns to the terrestrial surface. There are measurable inputs of all elements. The elements were accumulated in the order S greater than Fe greater than Mn greater than Zn greater than Pb greater than Cu greater than Ni greater than Cr greater than Co greater than Hg greater than Cd. The regional mean concentrations for the anthropogenically derived heavy metals were lower than levels reported for northern Ontario and southern Sweden. There are no comparable data for S concentrations in Sphagnum spp. High concentrations of Pb, Hg, and S were attributed to local anthropogenic emissions. Significant correlations in concentration were determined between the element pairs Fe-Co and Ni-Cr.

062080
ROBERTSON D * **A window on the wetlands, Chilanko Marsh** * BC Outdoors * 39(1) 53-55, 76 * Maclean Hunter Ltd, #202-1132 Hamilton St, Vancouver, BC V6B 2S2 * 1983-02.

This article describes a four-year waterfowl enhancement project being undertaken in the Chilanko Marsh, in the Chilcotin area of British Columbia. The Fish and Wildlife Branch of the Ministry of the Environment, Second Century Fund, and Ducks Unlimited are cooperating in the venture to convert a large central interior wetlands into a prime waterfowl habitat. The current management committee envisages constructing control dams along the 494 acre waterway to create four compartments, each to be managed separately to achieve maximum benefit. First stage of construction includes the main control, the ditch, and isolating a peninsula from the mainland to create an island compartment. With a water depth of over 3 feet, sedge growth will be inhibited providing open water for waterfowl in many more areas of wetlands. It is anticipated that each of the diversified compartments will produce its own distinct type of wildlife and varied plant life. The Chilanko project will offer waterfowl not only better breeding areas, but will provide secure ponds of open water and ample feed, which would attract both nesting and staging birds. Four public meetings in the Puntzi Lake area have ensured local involvement in the project.

067161
RUBEC C, MOORE J * **Wetland land use monitoring in Canada** . IN: Proc Peatland Inventory Methodology Workshop, 9-10 Mar 1982, Ottawa, Ont * MORGAN SM, POLLETT FC * 103-108 * Agric Can, land Resour Res Inst, and Environ Can, Nfld For Res Cent * 1983.

The evaluation of trends in land use changes within and around wetlands of prime importance across Canada is one issue of significant value for development of national strategies concerning the potential use of wetland and peatland ecosystems for energy applications. This paper overviews the current and planned wetland related programs of the Lands Directorate at Environment Canada and provides a discussion of areas of potential cooperation in field studies and research efforts.

063829
SCOTT L * **Saskatchewan's Heritage Marsh Program** * Blue Jay * 40(1) 3-5 * 1982-03

The Heritage Marsh Agreement of November 1981 to preserve and manage five major wetlands in Saskatchewan, is described. The Program is designed to preserve wetlands for the benefit of all forms of wildlife and addresses issues such as waterfowl crop depredation, flood and drought control, and sportsmen and naturalists interests. Operations and activities of Ducks Unlimited (Canada), Saskatchewan Government, Saskatchewan Wildlife Federation, Nature Conservancy of Canada, and Saskatchewan Natural History Society in this Program, are detailed. Two projects, Ponass Lake and the Thunder Creek Marshes, selected as Heritage Marshes, are described. Two fund raising projects of the Saskatchewan Natural History Society - sale of a Conservation Certificate and a lottery - are discussed.

062546
TAYLOR CH * **The effect on storm runoff response of seasonal variations in contributing zones in small watersheds** (see chapter 4.1 for complete reference - voir chapitre 4.1 pour la reference complete)

062021
TAYLOR GJ, CROWDER AA * **Accumulation of atmospherically deposited metals in wetland soils of Sudbury, Ontario** * Water Air Soil Pollut * 19(1) 29-42 * 1983-01.

Concentrations of Cu, Ni, Fe, and Mg in soil/sediment material from 25 wetlands in the Sudbury, Ontario, region decline logarithmically with increasing distance from several ore smelters. Total Cu and Ni reach concentrations potentially toxic to plant life in soil/sediment material near the smelters. Despite random variation in soil/sediment pH and Eh, NH4OAc extractable Cu, Ni and Fe, and DTPA extractable Cu Ni and Mg show the same pattern as total Cu, Ni, Fe, and Mg. The failure of DTPA extractable Fe to show the same pattern as total Fe may be due to the inadequancy of the DTPA soil test when testing Fe in acid soils. Soil/sediment organic C content increases with distance from the smelters, but is unrelated to pH or Eh.

065985
WATER SURV CAN, INLAND WATER DIR, ENVIRON CAN * **Water quantity/quality monitoring program, Cumberland Marshes Project, 1980 Annual report** * 42p * Prairie Prov Water Board * 1981-04-20.

The Cumberland Marshes water quantity/quality monitoring program was initiated in 1978 at the request of the Prairie Provinces Water Board. The program objectives are to collect surface water data that will produce a record of flow into and out of the project and determine trends in water quality and impacts, if any, on water quality that may be attributable to the Ducks Unlimited project. Water quantity data may also be used as an interpretive tool in the analysis of water quality trends. This 1980 report covers water management and surface water monitoring activities in the Ducks Unlimited (Canada) Cumberland Marshes project for calendar year 1980.

067160
WELLS ED, HIRVONEN H * **Patterned peatlands of Labrador: a classification and inventory problem** , IN: Proc Peatland Invent Methodol Workshop, 9-10 Mar 1982, Ottawa, Ont * MORGAN SM, POLLETT FC * 114-118 * 1983.

The peatlands of Labrador are mainly patterned with pools and strings of vegetation orientated at right angles to direction of slope. Since both fens and bogs have these surface features the identification and classification of different peatland types from conventional aerial photography is usually very difficult without ground truthing. This is an expensive component of any classification and/or inventory project; consequently, several peatland sites have been selected to determine if land-satellite imagery can be successfully employed to delineate and classify different bog and fen types.

062344
WHILLANS TH * **Changes in marsh area along the Canadian shore of Lake Ontario** * J Great Lakes Res * 8(3) 570-577 * 1982.

Baseline marsh area is approximated for the Canadian shoreline of Lake Ontario west of the Bay of Quinte using maps dated from 1789 to 1962. The measured difference between that and the area of marsh indicated on topographical maps dated from 1977 to 1979 reveals a net loss of about 4,000 acres or 57% of the baseline area for 38 marshes. Using extrapolation for another 24 marshes, the net loss for 62 marshes is estimated at approximately 4,745 acres or 43% of the baseline area. Losses were particularly high for marshes west of and including Toronto. Estimated net loss was lower in absolute terms, but similar in proportion to that from a previous study which was based on waterfowl production habitat. Relative losses of marsh area along the Canadian shoreline of Lake Ontario are consistently higher than previous estimates for inland wetlands in counties fronting the same shoreline. This and other studies suggest that heavily settled Great Lakes environments have generally lost up to 75% of their baseline wetland area and almost 100% in a few cases. The use of historic maps provides an early baseline estimate of wetland area, in some cases the only estimate possible, but it is less subject to standardization, probably reflects emergent vegetation, and is somewhat cumbersome.

065426
ZOLTAI SC * **An overview of the wetlands of Canada** , IN: First western hemisphere waterfowl and waterbird symposium, Proc Int Waterfowl Res Bur Symp, Edmonton, Alta, 25-28 May 1982 * BOYD H * 45-49 * Can Wildl Serv, Ottawa, Ont K1A 0E7 * 1983.

Wetlands occupy the waterlogged portion of the land, including peatlands and mineral soil surfaces that are saturated with water. Such wetlands are widespread across Canada, with particular kinds developing in various climatic regions in response to temperature and precipitation patterns. Characteristic wetlands, from arctic to temperate, and from semi-arid to temperate rain forest conditions, are described.

067171
ZOLTAI SC, JOHNSON JD * **Peatland ecology studies in the boreal wetland region** , IN: Proc Peatland Inventory Methodology Workshop, 9-10 Mar 1982, Ottawa, Ont * MORGAN SM, POLLETT FC * 2-5 * Agric Can, Land Resour Res Inst, and Environ Can, Nfld For Res Cent * 1983.

Studies of the dynamics of peatlands were undertaken in the Prairie Provinces to serve as background information for reconnaissance surveys. During such multidisciplinary studies different wetland types are identified, and the vegetation and peat sections are described as sampled. Chemical and physical properties of the peat are determined. Preliminary results of the first year of studies show that in central Alberta the long-term average rate of peat accumulation is about 0.55 mm/yr, with a dry matter peat increment of 50-60 g/sq m/yr. Vegetation communities identified from peat macrofossils are similar to those presently occurring in the area.

4.10 Coastal and Shore Processes - Processus touchant les rives et les rivages

063769
BARKER ML, MORGAN WB * **Shore and floodplain management in British Columbia and Washington State, Chapter 6** (see chapter 4.2 for complete

reference - voir chapitre 4.2 pour la reference complete)

062773
BISHOP CT * **A shore protection alternative: artificial headlands** . IN: Proc Canadian Coastal Conf 1983, Vancouver, 11-14 May 1983 * HOLDEN BJ * 305-319 * Natl Res Counc, Assoc Comm Res Shoreline Erosion Sediment, Ottawa, Ont K1A OR6 * 1983.

The use of artificial headlands to protect shorelines is discussed. Empirical relations allow the prediction of the ultimate stable configuration of an erodible shoreline between resistant headlands. Examples of natural and man-made headland-bay shores are cited. In some cases, shore protection by headland control may be preferable to the use of groynes, seawalls or simple artificial beach nourishment.

062774
BOCZAR-KARAKIEWICZ B, BONA JL * **Shallow-water waves over a gently sloping beach** . IN: Proc Canadian Coastal Conf 1983, Vancouver, 11-14 May 1983 * HOLDEN BJ * 323-324 * Natl Res Counc, Assoc Comm Res Shoreline Erosion Sediment, Ottawa, Ont K1A OR6 * 1983.

Surface gravity waves in comparatively shallow water may affect the bottom topography over which they propagate. Our studies have shown that in some regimes wave-bed interactions cause systems of multiple, shore-parallel sand bars to be formed (Boczar-Karakiewicz, Bona and Dette 1983).

063697
COORD TASK FORCE, CANADA/ONTARIO GREAT LAKES DAMAGE SURV FOLLOW-UP PROGRAM * **Canada/Ontario Great Lakes shore damage survey follow-up program, final report** * 9p * 1982-04.

The Canada/Ontario Great Lakes Shore Damage Survey Follow-up Program was a cooperative venture of the Ontario Ministry of Natural Resources, Fisheries and Oceans Canada, and Environment Canada. The major accomplishments of the Coordinating Task Force are: preparation and distribution of maps delineating the 1:100 year flood line and the 100 year erosion limit for the Canadian shoreline of the Great Lakes from Sauble River to Gananoque; preparation and distribution of the Great Lakes Shore Management Guide; collection, evaluation and interpretation of shore erosion data from Port Severn to Kingston, and preparation of an erosion survey report; and establishment of a public information program on the hazards of shoreline flooding and erosion, and procedures to avoid these hazards. In 1975 "Canada/Ontario Great Lakes Shore Damage Survey: Technical Report" was published, with recommendations on: hazard lands definition; coastal zone management policies; site-specific studies; shoreline management/land use simulation model; public awareness program; shore monitoring; and research on shore processes and shore protection. This final report discusses each of these recommendations, and outlines what has been done from April 1, 1976 to March 31, 1982 to implement them.

062324
DAVIDSON-ARNOTT RGD, KEIZER HI * **Shore protection in the town of Stoney Creek, southwest Lake Ontario, 1934-1979: historical changes and durability of the structures** * J Great Lakes Res * 8(4) 635-647 * 1982.

A study of shore protection measures used by private property owners was carried out along a 10-km stretch of shoreline in the town of Stoney Creek, western Lake Ontario. The area is characterized by low bluffs developed in silty-clay till, with average rates of recession generally in excess of 1.0 m per yr. Aerial photographs, questionnaires, and field observations were used to compile information on type, dimensions, material used for construction, and state of repair for each structure present at a number of dates between 1934 and 1979. During this period the proportion of protected shoreline rose from 30% to 64%. Seawalls and groynes are the most common form of shore protection, with 60% of properties now protected by a combination of the two. An examination of the durability of individual structures over the whole period indicates that, on average, 71% are damaged or destroyed within 10 years of construction and 87% within 20 years. These rates are highest during periods of high lake levels and lowest during low levels. The low durability reflects poor design and construction of the structures, lack of cooperation between property owners, and the stresses imposed by the physical environment. While the durability of structures can be improved, this would require much greater expenditure and cooperation.

062756
DICK TM, ZEMAN AJ * **Coastal processes on soft shores** . IN: Proc Canadian Coastal Conf 1983, Vancouver, 11-14 May 1983 * HOLDEN BJ * 19-35 * Natl Res Counc, Assoc Comm Res Shoreline Erosion Sediment, Ottawa, Ont K1A OR6 * 1983.

The characteristics of shores which erode rapidly are described and the processes are outlined. Results of annual topographic surveys of a section of Lake Erie northern shore are used to illustrate the difficulty of obtaining measurements of shore recession rates. Annual rates of shore recession are shown to vary considerably both as a function of time and of location. A model is proposed which gives the recession of the toe of the bluff as a function of the work done by waves. Some verification of the concept is obtained but other information is contradictory. The data available do not permit an evaluation of

the effect of a sand bed near the bluff.

063774
DORCEY AHJ * **Strategies for coastal resource management in western Canada - while battles are being won, is the war being lost?, Chapter 14** , IN: Water problems and policies * SEWELL WRD, BARKER ML * Cornett Occas Pap No 1 * 157-163 * Dep Geogr, Univ Victoria, Victoria, BC V8W 2Y2 * 1980.

This paper reviews the present status of estuary management in British Columbia, the development of small scale mariculture industries and pollution control. A discussion of these three aspects of coastal resource management illustrates important characteristics of the problem areas of western Canada. Based on research that has been undertaken at the Westwater Research Centre, three conclusions about the present approaches to management on the West Coast are reached: (1) impact assessment procedures frequently cannot do what is expected of them; (2) research is being neglected, and (3) planning is greatly underutilized. Two changes are suggested that would make for better informed judgement on the use of British Columbia's coastal resources: (1) reallocate some of the effort from impact assessment into research, and (2) integrate planning, research, and impact assessment into coordinated management strategies. The integration of planning, research, and impact assessment procedures could be the basis for a new approach to coastal resources management.

062761
HOLDEN BJ (ED) * **Proceedings, Canadian Coastal Conference 1983, May 11 - 14, 1983, Vancouver** * 330p * Natl Res Counc, Assoc Comm Res Shoreline Erosion Sediment, Ottawa, Ont K1A OR6 * 1983.

The purpose of the conference was to provide an interdisciplinary forum for the discussion of Canadian scientific research and engineering practice in the nearshore environment. The application of science is stressed by alternating papers concerning scientific research and engineering practice. Scientific papers were related to physical processes, data acquisition and management, post-project evaluation, and theory of potential practical application to engineering design in coastal settings. Engineering papers treated contemporary practices and problems relating to the application of physical data and processes or scientific models for coastal engineering design. Sessions were held on: coastal processes; field investigations; waves; Canadian coastal sediment study; field measurements; modelling; and coastal protection. Many more papers were received than could be scheduled into the regular program. To accommodate this interest the poster display idea was used and participants were invited to submit a short summary of their work for inclusion in the proceedings. All papers and display summaries received in time for publication are included in these proceedings.

F11363
INST OCEANOGR BEDFORD * **Ingenierie cotiere** * Rev de l'IOB * 32-38 * Inst oceanogr Bedford * 1981.

Pour prevoir avec precision les incidences environnementales des grands travaux projetes dans les zones cotieres, il faut faire appel a deux types d'etudes scientifiques. Les premieres, qui entrent dans le mandat general de l'Institut, sont des travaux de longue duree sur les processus environnementaux de base. Les travaux du second type, qui dependent totalement des premiers, sont des etudes a court terme qui portent sur l'interaction des processus environnementaux importants et d'un projet bien precis. Ces derniers temps, l'Institut a accorde une attention particuliere a des travaux sur l'ecologie fondamentale de la baie de Fundy, ou pourrait etre construite une usine maremotrice; a la mise sur pied d'un programme de surveillance des phases preoperationnelle et operationnelle de la construction de la centrale nucleaire de Pointe Lepreau (Nouveau-Brunswick); enfin, aux incidences de la construction de la digue de Canso sur la peche du homard.

062767
KAMPHUIS JW * **Preliminary discussion of scale effects tests on large coastal mobile bed models** , IN: Proc Canadian Coastal Conf 1983, Vancouver, 11-14 May 1983 * HOLDEN BJ * 237-251 * Natl Res Counc, Assoc Comm Res Shoreline Erosion Sediment, Ottawa, Ont K1A OR6 * 1983.

This paper is a preliminary discussion of a series of scale effects tests performed on large coastal mobile bed models of artificial islands. The background leading up to the tests is given, the measurement procedures are discussed and very preliminary results of benchmark tests are presented.

062338
KANG SW, SHENG YP, LICK W * **Wave action and bottom shear stresses in Lake Erie** * J Great Lakes Res * 8(3) 482-494 * 1982.

For Lake Erie, the amplitudes and periods of wind-driven, surface gravity waves were calculated by means of the SMB hindcasting method. Bottom orbital velocities and bottom shear stresses were then calculated using linear wave theory and Kajiura's (1968) turbulent oscillating boundary layer analysis. These calculations were made for south-west and north wind directions and a steady wind speed of 40 km per hr. Calculated bottom shear stresses are related to the textural properties of surficial Lake Erie sediments as

determined by Thomas et al. (1976). The bottom shear stresses, especially under prevailing southwest wind conditions, control the textural characteristics of surface sediments in Lake Erie. In particular, wave-induced bottom shear stresses are probably the most important energy source for sediment entrainment.

062763
KRAUEL DP * **Comparison of two approaches to wind wave hindcasting** . IN: Proc Canadian Coastal Conf 1983, Vancouver, 11-14 May 1983 * HOLDEN BJ * 123-133 * Natl Res Counc, Assoc Comm Res Shoreline Erosion Sediment, Ottawa, Ont K1A OR6 * 1983.

Most coastal engineering studies require a knowledge of the frequency distributions of wave heights and periods by direction or the directional wave energy flux. Two simple models based on the SMB equations and which use observed winds to hindcast waves for limited fetch coastal areas are compared with observed wave data. The first model hindcasts hourly wave parameters from which frequency distributions are subsequently determined while the second model determines the wave frequency distributions directly from the wind speed and direction frequency distributions. The results of both models are similar and compare favorably with observed wave data.

063341
KREUTZWISER R * **Cottager associations in Ontario: an exploration of their involvement in shoreline issues** . IN: Coastal studies in Canadian geography, No 1, Can Assoc Geogr Conf, Corner Brook, Nfld, August, 1981 * RICKETTS PJ * Stud in Mar and Coastal Geogr No 1 * 131-139 * St Mary's Univ, Halifax, NS B3H 3C3 * 1982-04.

This paper describes characteristics and activities of Ontario cottager associations, with emphasis on their involvement in shoreline issues. It identifies problems of importance to cottagers and explores the nature and effectiveness of association involvement in attempting to influence government decision-making on these problems. A brief review is given of previous studies of cottager associations and of related research. Information for this study was obtained from completed mail-back questionnaires that were returned by cottager associations. The most significant feature of cottager associations is the dramatic recent growth in their numbers in Ontario. Other features of note include association raison d'etre, organizational-institutional attributes and human and financial resources of the associations. Water quality, municipal services, taxes, and access to local decision-making were among the issues perceived as important by Ontario cottager associations. Evidence obtained suggests that governments at all levels can no longer ignore the existence of cottager associations as an emerging element in the decision-making process respecting shoreline problems. Mechanisms must be devised to afford cottager associations greater opportunities for participation in decision-making and channelling association effort into more effective management of shoreline and lake resources.

062457
MCCANN SB, DALE JE, HALE PB * **Subarctic tidal flats in areas of large tidal range, southern Baffin Island, eastern Canada** * Geogr Phys Quat * 35(2) 183-204 * Presses Univ Montreal, Montreal, Que H3C 3J7 * 1981.

Wide, boulder-strewn intertidal flats occur around the head of Frobisher Bay and along parts of the shoreline of Cumberland Sound, in southeast Baffin Island. The coastal environment is characterized by large tidal ranges, severe winter sea ice conditions, and a relative sea level history which involves rapid and then decreasing land emergence during the earlier part of the Holocene, succeeded by slight recent submergence. Summer field investigations were carried out at two sites, Koojesse Inlet on Frobisher Bay, where ice breakup conditions were also monitored, and Pangnirtung Fiord off Cumberland Sound. The results are summarized under three headings: physical and biological zonation across the tidal flats; tidal action and sea ice processes; and geological evolution of the tidal flats. Comparisons are made with similar settings described by others in Labrador and Ungava Bay. The sedimentary shores at both Baffin Island sites exhibit a distinct physical zonation, most evident in the concentration of boulders in the middle tidal flat zone at Koojesse Inlet and in the boulder barricade at the seaward margin of the Pangnirtung flats. Biological observations show a zonation of intertidal flora and fauna across the intertidal zone at Koojesse Inlet. An outstanding problem concerns the mode of transport of very large boulders. Pushing and rolling, by ice floes which are confined to the intertidal zone by the solid ice in the offshore zone during the critical early phase of breakup, may be more appropriate processes than ice rafting.

062764
MURTY TS * **Storm surges and tsunamis on the coastlines of Canada** . IN: Proc Canadian Coastal Conf 1983, Vancouver, 11-14 May 1983 * HOLDEN BJ * 135-148 * Natl Res Counc, Assoc Comm Res Shoreline Erosion Sediment, Ottawa, Ont K1A OR6 * 1983.

Storm surges and tsunamis are long period gravity waves in water bodies generated by traveling weather systems (for storm surges) and under ocean earthquakes, volcanic explosions and submarine landslides (for tsunamis). Tsunamis have occurred on the Pacific, Arctic and the Atlantic coasts of

Canada. Storm surges occur in Lake Erie, St. Lawrence Estuary, James Bay, Hudson Bay, on the Atlantic coast, Bay of Fundy, Gulf of St. Lawrence, Lakes Huron and Ontario, Lake Winnipeg, Southern Beaufort Sea. Major surges do not occur on the west coast. Ice damps positive surges more than negative surges. Tide-surge interaction occurs in St. Lawrence estuary.

062702
OLRIK K, CHRISTENSEN JH • **Toxic algae: an environmental and health problem in coastal areas and lakes** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference

062759
OWENS EH, HARPER JR • **Arctic coastal processes: a state-of-knowledge review** . IN: Proc Canadian Coastal Conf 1983, Vancouver, 11-14 May 1983 • HOLDEN BJ • 3-18 • Natl Res Counc, Assoc Comm Res Shoreline Erosion Sediment, Ottawa, Ont K1A 0R6 • 1983.

The dynamics and the form of North American arctic shorelines are controlled by the coastal processes that characterize this high latitude, cold climate environment. Whereas on most of the world's coasts wave action is the dominant littoral process, in arctic environments ice also plays an important modifying role in the shore zone. Sea-ice, shore-zone ice, and terrestrial ice each affect coastal processes in different ways. This review describes our present knowledge base for the North American arctic and indicates unique environmental problems for the design of coastal structures or for shore-zone development in the Arctic.

063339
RICKETTS PJ (ED) • **Coastal studies in Canadian geography, Papers presented at a special session of the Canadian Association of Geographers Annual Conference, Corner Brook, Newfoundland, August, 1981** • Stud in Mar and Coastal Geogr No 1 • 142p • St Mary's Univ, Halifax, NS B3H 3C3 • 1982-04.

The prospect of the development of offshore sources of hydrocarbon fuels and the possible onshore impacts of such, dominated the themes of the papers presented. Four papers dealt directly with the prospects of offshore oil and gas, considering the impacts of such development on land-use regulations, and unemployment and demographic conditions in Newfoundland and on the Atlantic fishing industry. The validity of comparing areas which had already felt the impacts of offshore development (Scotland and Alaska) to conditions in the Beaufort Sea was investigated. The problems of predicting patterns of sea-ice retreat was discussed and trends in the dates of clearing were studied. Recent changes in the fisheries industry of Nova Scotia were analyzed and the relationship between geomorphological factors and the potential support of Atlantic Salmon populations in Quebec rivers was considered. The geopolitical and resource factors concerning the negotiation of the now defunct East Coast Fisheries agreement were analyzed along with its implications for the international boundary dispute between Canada and the United States. An abstract is presented of another paper also dealing with the geographic and resource considerations involved with that boundary dispute. The remaining papers covered various shoreline issues on the Great Lakes and the west coast. The influence of cottager associations in shoreline issues in Ontario was examined. An assessment was made of wetland use regulation on Long Point, Lake Erie and an investigation presented of the processes through which coastal resources are allocated and used in British Columbia. The latter two papers are presented in abstract form.

062456
TRENHAILE AS, RUDAKAS PA • **Freeze-thaw and shore platform development in Gaspe, Quebec** • Geogr Phys Quat • 35(2) 171-181 • Presses Univ Montreal, Montreal, Que H3C 3J7 • 1981.

The role of freeze-thaw action in coastal environments, with particular reference to the formation of sub-horizontal shore platforms in Gaspe, Quebec, was investigated experimentally. Rock cores and crushed rock samples were subjected to: two freeze-thaw cycles of twelve and twenty-four hour durations; fresh water and three artificial sea water solutions of about half, one and a half, and 'normal' salinity; and two drainage conditions representing rock pools and vertical well drained surfaces. These variables were selected to simulate some of the local environments which exist between the cliff top and low tide level in coastal Gaspe. Shales were the most susceptible to frost breakdown, followed in turn by argillites, calcisiltites and dolomitic silty argillites, and gray-wackes. Greatest disintegration tended to be associated with sea water solutions of about half-normal salinity. The data suggest that breakdown is greatest in the lower portions of the liff. Freeze-thaw may produce the moat-like pools commonly found at the back of shore platforms. Although the process undoubtedly facilitates wave erosion of the platform and cliff, however, there is no evidence to suggest that it causes shore platforms to assume subhorizontal gradients.

063796
WEAVER RK • **Computer programs for geophysical profile data** • Tech Note Ser 82-1 • 124p • Fish Oceans Can, Oceanogr Div, Ocean Sci Surv, Bayfield Lab Mar Sci Surv, Burlington, Ont • 1982-01.

This report presents a series of computer

programs that can be used to archive, invoice, edit and output geophysical profile data. Sample outputs are taken from Shore Properties Studies (SPS), Erosion Monitoring Programme data. All programs were written for a CDC Cyber 171, using FORTRAN IV EXTENDED. All job control language is under NOS (Network Operating System), for the Cyber 171.

062638
WOODWARD-CLYDE CONSULT, 16 BASTION SQUARE, VICTORIA, BC V8W 1H9 * **Physical shore-zone analysis of the Labrador Coast, Final report** * vp * Petro-Canada, Box 2844, Calgary, Alta * 1980-08-28.

This analysis of the physical shore-zone of Labrador describes the geological, atmospheric and oceanographic, and the coastal environment of the region. The data and information are derived from an interpretation of vertical aerial photographs, map analyses and from aerial reconnaissance surveys. The primary physical characteristics of the shore-zone of Labrador is described in terms of 6 regional coastal environments and 5 shoreline types. The primary character of the coast is associated with high relief, bedrock and fjords, while the extensive boulder flats and boulder barricades form a significant secondary component. The regional trends reflect minor variations in shoreline character rather than fundamental differences between dominant shoreline types. The only exception is the inland coastal environment of Lake Melville where low relief and the abundance of unconsolidated sediments is favourable to the development of extensive beaches. The coasts of Labrador are stable, in terms of rates of shoreline change due to the resistant bedrock outcrops, except Lake Melville where unconsolidated coastal cliffs are eroded by marine processes.

4.11 Water Supply, Demand, Use, Drought - Approvisionnement, demande, utilisations, secheresse

063206
Fish habitat monitor * 1(1) 4p * Habitat Manage Div, Dep Fish Oceans, Pac Reg, 1090 West Pender St, Vancouver, BC * 1982.

This Bulletin on habitat operations is published by and available on request from the Habitat Management Division (HDM) of the Department of Fisheries and Oceans, Pacific Region, 1090 West Pender St, Vancouver, BC. The publication is intended to expand awareness of both the habitat risks and opportunities posed by loggers, ranchers, miners, urban or industrial planners, and highway and dam builders.

064856
ALTA ENVIRON, PLANN DIV, PLANN SERV BRANCH * **Milk River basin study water use** * vp * Alta Environ, Environ Eng Support Serv * 1980-08.

This study investigates water uses for municipal, industrial and agricultural purposes in the Milk River Basin, Alberta, and focuses primarily on withdrawal water uses and current patterns in use. Included in the report is a compilation, review and analysis of available surface water use data for municipal, agricultural and industrial purposes in the basin. Potential industrial activities such as hydro-power, thermal power, oil and gas, and petrochemical developments, are examined. Existing and potential water use conflicts are identified, and the data presented are expected to aid the basin planners in developing an overall efficient framework plan for managing the basin's water resources.

064223
ALTA ENVIRON, POLLUT CONTROL DIV, MUNICIP ENG BRANCH * **Calgary region wastewater irrigation study** (see chapter 8 for complete reference - voir chapitre 8 pour la reference complete)

065881
ARMSTRONG B, MILBURN B * **Water conservation in the Northwest Territories, Public Education and Awareness Program** , IN: Proc 3rd Symp on Utilities Delivery in Cold Regions, May 25-May 26, 1982, Edmonton, Alta * SMITH DW * Econ Tech Rev Rep EPS 3-WP-82-6 * 125-139 * Environ Can, Environ Prot Serv, Ottawa, Ont K1A 1C8 * 1982-12.

One of the recommendations of a joint 1977 study by the Government of the Northwest Territories and Environment Canada, a public education and awareness program to promote an awareness of the need to conserve and the potential benefits to be derived from water conservation, is described. The direct economic benefits are discussed focusing on the need to make the consumer aware of the program's rationale and the potential benefits. The implementation of a campaign program in 1981 to educate the public, concentrating on the presentation of seminars and a multi-media campaign, is outlined. The objective of the seminars was to acquaint the northern people with easy, in-home methods of water conservation. A description of response to the seminars and of the community itself is provided for Rankin Inlet, Frobisher Bay, Fort Smith, Hay River, Yellowknife, Inuvik, and Cambridge Bay. Observations on the program and its results are presented. A 1982 follow-up to the program, is also included.

062298
CAN RESOURCECON LTD, MAYLAND OFF PARK 2, #205 - 825 MANNING GARDENS NORTHEAST, CALGARY, ALTA * **Water use in the North Saskatchewan River**

Basin * 146p * Alta Environ, Plann Div * 1982-07.

This report forecasts water use in the North Saskatchewan River Basin from 1981 to 2001. A description is given of the river basin and current water licenses are listed. Population estimates and population projections are given for each of the twelve separate reaches of the basin. Patterns and trends in water use are discussed under the categories: residential and municipal water use, water use for thermal power generation, oilfield activities, industrial uses, agricultural water uses, and forest related water uses. A summary is presented of total water demand for 1981 as well as forecasted water demand for the years between 1981 and 2001. Seasonal variations in the use of water are discussed. Groundwater demand and supply are examined and estimates are given of current and future withdrawals of surface water between 1981 and 2001. Current statistics and projections relating to population and water use are presented in tables in the appendices to the report.

061802
CORBU I, THOMPSON K * **RRM - a computer model with capabilities of assessing recreational and environmental constraints**, IN: Proc 35th Annu Conf Canadian Water Resour Assoc on water-based recreation issues, conflicts, strategies, Minett, Ont, 1-4 June 1982 * WILLIAMS P * Can Water Resour J * 7(4) 126-146 * Can Water Resour Assoc, PO Box 250, Kingston, Ont K7L 4V8 * 1982.

The River Regulation Model (RRM) was developed as a cooperative Federal-Provincial effort for the operation of the Ottawa River and its tributaries. It is a generalized model and can be applied as is or with slight modifications to other river systems. RRM has the capability of including recreational and environmental constraints on river flows and reservoir levels anywhere in a river system. Furthermore, it can be used to determine the effect of these constraints on other user interests, e.g., energy, navigation, logging, low water flows, etc. This paper exemplifies these capabilities of the model. Water-resource planners and managers can use this model as a valuable tool to deal effectively and efficiently with recreational and environmental issues and/or conflicts related to river systems.

061885
DEMCOE P, DANZINGER WA * **Potential for water slurry transport of Alberta coal to Pacific tidewater** * J Can petrol Technol * 21(4) 65-70 * 1982.

Worldwide demand for commodities produced in Western Canada is expected to increase significantly over the next ten years. Coal, grain, sulphur, potash and other commodities are expected to swell freight volumes by 1990. In the past, the railways have responded to increased traffic with system upgrading on a progressive basis, but they indicate that what is needed now is a major program of capacity expansion. This will be the largest railway undertaking since the original lines were constructed. Coal is a major contributor to this unprecedented growth in traffic volume to the West Coast. In 1980, 14.1 million tonnes were exported. By 1985, the demand is expected to be 39.9 million tonnes and is predicted to reach 53.3 million tonnes by 1990. Although the present unit train system of moving export coal to seaboard is considered to be one of the world's most efficient, rail capacity problems pose a serious threat to Canada's potential for supplying a significant portion of world steam coal requirements. How then can the pressure on the transport system be alleviated? The Alberta Government decided to investigate a coal slurry pipelines as an alternative method of transport for coal.

065436
DURRANT EF * **An appraisal of future water needs and sources** * 57p * Water Resour Plan and Invest, Regina, Sask * 1983-06.

This paper deals with the southern parts of the provinces of Alberta, Saskatchewan, and Manitoba, and the problems that will arise from a certain set of future water demands. The present needs for water are compared with the amount and quality of water presently available. Assumptions are given regarding growth in urban population, industry, and irrigation, between now and the year 2030. Possibilities for increasing the useable supply of water through the construction of storage and diversion projects are discussed, as well as the influence of alternative planning frameworks on development.

062138
ENVIRON CAN * **Prairie provinces water use study released** * 3p * Environ Can * 1983-02-10.

A comprehensive study of water use in the prairie provinces is released by federal and provincial ministers responsible for the Prairie Provinces Water Board. Entitled "Water Demand Study - Historical and Current Water Uses in the Saskatchewan-Nelson Basin", the report documents in detail past water uses and points to some trends in future water use. The main report and 7 volumes of appendices are available from the Prairie Prov Water Board, Room 306, Motherwell Build, 1901 Victoria Ave, Regina, Sask S4P 3R4. For further information, contact RB Godwin, Prairie Prov Water Board, Regina, Sask.

063255
ENVIRON COUNC ALTA * **Irrigation agriculture in Alberta** (see chapter 8 for complete reference

- voir chapitre 8 pour la reference complete)

06269C
HAMILTON RE, KOSAKOSKI GT * **Water requirements for the fisheries resource of the Englishman River, Vancouver Island, B.C.** * Can Manuscr Rep Fish Aquat Sci 1676 * 49p * Dep Fish Oceans, Pac Reg, Vancouver, BC * 1982-09.

The hydrology of the Englishman River is examined and low flows analysed. The most critical low flow period is between August 10 and September 20 when it is most probable that river flow will drop below 25 cfs. Data is provided on distribution, timing, and escapement of the several Pacific salmon (Oncorhynchus spp.) species. A biophysical inventory is included. Spawning and rearing habitat was studied in detail. Useable habitat versus discharge curves were prepared and rearing populations were estimated. Recommendations for Fisheries Resource Maintenance Flows are 40 cfs for rearing and 200 to 300 cfs for spawning. It is recommended that a minimum of 500 acre feet of storage be provided to support the water diversion licence applied for by the town of Parksville and that it be released to fully support the diversion when the river flow drops below 25 cfs.

062750
HURDEY SE, SCOTT JD * **Water reuse needs of the oil sands industry in Alberta** . IN: Water reuse in the future, Proc Water Reuse Symp II, 23-28 Aug 1981, Washington, DC Vol 3 * 1979-2004 * Am Water Works Assoc (AWWA) Res Found, 6666 West Quincy Ave, Denver, CO 80235 US * (1981).

The inevitable decline in global reserves of conventional crude oil has created increasing interest in heavy oil development. It has been estimated that 40% of the world's oil and 90% of Canada's oil supply is contained in heavy oil deposits. The majority of Canada's reserves are located in the oil sands deposits of Alberta. The technology of oil sands exploitation involves high water demands with a significant fraction as consumptive use (onsite retention). Although current operations employ a significant degree of water reuse, concern over long term storage of excess wastewater and projected expansion of oil sands exploitation make increased water reuse very desirable.

061800
KITCHEN BW * **Trent-Severn waterway conflicts** . IN: Proc 35th Annu Conf Canadian Water Resour Assoc on water-based recreation issues, conflicts, strategies, Minett, Ont, 1-4 June 1982 * WILLIAMS P * Can Water Resour J * 7(4) 81-95 * Can Water Resour Assoc, PO Box 250, Kingston, Ont K7L 4V8 * 1982.

Whenever a large number of different activities are based upon a single resource, conflicts are inevitable. The Trent-Severn system of dams controlling the water levels and flows in a large recreational area is just such a situation. Whitewater canoeing requires flow to be taken from reservoir headwater lakes while cottaging on these lakes is enhanced when the water level remains high. Lock operation with adequate advertised draught through the evaporation losses from canal route lakes be replaced with water from the reservoir lakes, also detrimental to the reservoir cottager. Fish spawning requires certain flows of water at certain times in certain locations just at a time in some years when flow must be reduced to ensure filling the lakes for summer. Power production, flood control, agriculture, water quality and municipal water supply are among the further concerns of Trent-Severn Waterway in controlling flows. The primary raison d'etre of the Trent-Severn Waterway is to provide through navigation for boats from the Bay of Quinte on Lake Ontario to Georgian Bay on Lake Huron. Parks Canada, which administers the Trent-Severn Waterway, also encourages recreation of many forms: cottaging, whitewater canoeing, and sport fishing. Power production, water quality requirements, the maintenance of nature habitats, municipal and agricultural uses are also not to be forgotten. Flood mitigation is also a major concern. The water management of this complex system of lakes and rivers as well as the constraints implied by interested groups and legal agreements make for a very challenging and rewarding operation.

062680
KOSAKOSKI GT, HAMILTON RE * **Water requirements for the fisheries resource of the Nicola River, B.C.** * Can Manuscr Rep Fish Aquat Sci 1680 * 138p * Dep Fish Oceans, 1090 West Pender St, Vancouver, BC * 1982-09.

The hydrology of the Nicola River system is examined and low flows analysed. Data on the fisheries resource is summarized including distribution, timing, and escapements of salmon (Oncorhynchus spp.) stocks utilizing the Nicola River and its principal tributaries, the Coldwater River and Spius Creek. Information on the economic value of the fisheries resource is also provided. Spawning and rearing habitat was studied in detail using 6 transects on the Coldwater River and 16 transects on the Nicola River. Useable habitat area versus discharge curves were prepared, from which Fisheries Resource Maintenance Flow (FRMF) requirements were determined for these systems. Recommendations are made regarding regulation of storage on Nicola Lake for the benefit of the fisheries resource.

F11614
LALONDE M * **Portrait de l'utilisation de l'eau par les industries, bassin versant de la**

riviere du Nord * Rapp E.D.-7 * 45p * Minist de l'environ du Que * 1981.

Ce rapport s'inscrit dans le cadre du Programme de connaissances integrees des ressources en eau mene par le ministere des Richesses naturelles du Quebec. Il vise a presenter le portrait de l'utilisation industrielle de l'eau, par le recensement des industries manufacturieres et la mise en evidence des aspects quantitatifs et qualitatifs de l'utilisation de cette ressource. Ce document se divise en trois parties; la premiere donne une image de l'utilisation de l'eau par type d'industrie, la seconde met en evidence les principaux etablissements manufacturiers par municipalite, et la derniere partie trace un portrait de l'utilisation de la ressource par les industries sur l'ensemble du bassin de la riviere du Nord.

066724
MONTREAL ENG CO LTD * **Final report, Southwestern Nova Scotia water supply requirements and development feasibility, Phase II Southwestern Nova Scotia Water Resources Evaluation Project** * 100p * Montreal Eng Co Ltd, 5670 Spring Garden Rd, Halifax, NS B3J 3J1 * 1981-09-11.

This report represents the findings of the study entitled "Southwestern Nova Scotia Water Supply Requirements and Development Feasibility". The study was a part of the second phase of the Southwestern Nova Scotia Water Resources Evaluation Project and was funded under the Canada-Nova Scotia Planning Subsidiary Agreement. The study involved an evaluation of the surface water and groundwater resources in the study area and an assessment of their ability to meet water demands from the industrial, municipal and commercial sectors in the area. It was found that surface water is generally abundant from inland lakes and rivers although the majority of water users are located close to the coast, thus making development of surface water supplies a costly proposition. Surface waters in the area are generally acidic, and high in colour, iron and manganese, thus requiring treatment before use as a domestic or industrial source of supply. Most groundwater supplies in the study area are obtained from poorly permeabile bedrock and glacial overburden. However, there does appear to be a potential for future groundwater development in various sand and gravel deposits located throughout the region. The fish processing industry has been identified as the major water user within the study area. There are seven existing major surface water supply systems with Yarmouth and Shelburne being the only communities serviced by municipal systems. Fish processing plants often use saltwater and in the Woods Harbour area saltwater is subject to bacterial contamination but this problem could be removed by the construction of a new saltwater intake to service several plants. There is a general problem with freshwater supplies in the study area but it is probably most severe on Cape Sable Island where the highest concentration of fish plants occur. French Lake does have the potential for servicing this area but installation of a water treatment plant would be required.

065746
MUZIK I * **Drought analysis without site-specific data: a case study** , IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * 23-36 * Can Soc Civ Eng * (1983).

A method of estimating mean monthly discharges at an ungauged site is presented. The method is based on a simple linear regression of ungauged site discharges on discharges at a base station with a long term record. Regression coefficients of the regression equation are statistically related to watershed characteristics by two regional equations. The method is illustrated by a case study.

062992
ONT MINIST ENVIRON AND ONT HYDRO * **Implications on water use of cooling water releases from Pickering NGS to Lake Ontario under winter conditions** * 16p * 1981-06.

This report addresses concerns that have arisen during the review of the application by Ontario Hydro to the Ontario Ministry of the Environment for a Certificate of Approval to discharge cooling water from Pickering 'B' Nuclear Generating Station (NGS) into Lake Ontario. The specific concerns are the potential effects during winter (December - March) of the cooling water discharge from Pickering NGS 'A' and 'B' on: the quality of water extracted from Lake Ontario by water supply plants of the Region of Durham; the dispersal of effluent from the York-Durham sewage treatment plant; the incubation of eggs of fall spawning fish species that may be found within the area. To address these concerns there are presented in this report: a summary of the results of field investigations that were undertaken to characterize the behaviour of the cooling water discharge (thermal plume) from Pickering NGS 'A' during winter; a summary of mathematical modelling investigations that were undertaken to predict the behaviour of the combined cooling water discharge from Pickering NGS 'A' and 'B' in winter; and, a discussion of the implications of potential effects of the combined cooling water discharge from Pickering NGS 'A' and 'B' on other water uses, and conclusions derived therefrom.

062009
OOSTERVELD M, NICHOLAICHUK W * **Water requirements, availability and development restraints for increased crop productivity in Canada** (see chapter 8 for complete reference - voir chapitre 8 pour la reference complete)

062255
PLANN SERV BRANCH, PLANN DIV, ALBERTA ENVIRON * **Nose Creek water management study, environmental overview** (see chapter 2 for complete reference - voir chapitre 2 pour la reference complete)

063571
PRAIRIE PROV WATER BOARD * **Water demand study, Historical and current water uses in the Saskatchewan - Nelson Basin, Appendix 3, Agricultural water uses** * vp * Prairie Prov Water Board * 1982.

This agriculture study, prepared as a component of the Prairie Provinces Water Board's study of historical and current water use in the Saskatchewan - Nelson Basin, compiles current and historical statistics on water use in the agriculture sector for the period 1951-1976 and 1977 and 1978, where possible, organizes these data into an analytical framework that can be updated as required, and analyzes the factors, both physical and economic, that influence the amount of water used in the agriculture sector. The agriculture sector studies are related to three primary water uses: domestic use by the farm population; stockwatering; and, irrigation including both private and district operations. Agricultural water used in the sub-basins - North Saskatchewan River, Red Deer River, Bow River, Oldman River, South Saskatchewan River, Saskatchewan River, Qu'Appelle River, Old Wives Lake, Assiniboine River, Souris River, Pembina River, Red River, Winnipeg River, Lakes, and Nelson River - is described. Factors affecting irrigation development are presented and discussed. Conclusions reached regarding the need for maintaining or improving the data base are formulated in nine specific recommendations.

063570
PRAIRIE PROV WATER BOARD * **Water demand study, Historical and current water used in the Saskatchewan - Nelson Basin, Appendix 1, Regional economic base** * 517p * Prairie Prov Water Board * 1982.

This study, prepared as a component of the Prairie Provinces Water Board's study of current and historical water use in the Saskatchewan-Nelson River Basin, determines the nature of the current (1976) economic base of the Basin and traces its historical development from 1950, provides data and analysis regarding this economic base suitable for use in other studies as well as the overall project and in possible forecasting of water demands that may be undertaken, formulates a system of sub-regions for storing, manipulating and analyzing the data, and provides disaggregated data for a centralized data storage and retrieval system. The report includes four major statistical sub-sets: population, agriculture, mineral extraction, and manufacturing. The population sub-set is composed of urban/rural, age/sex and income breakdowns. Analysis consists of a computation of growth rates and a discussion of population and farm population comprise the agricultural sector. The industrial sector consists of data on employment, wages and salaries, value of shipments and value added. Major sub-sets are then brought together in presenting profiles of each sub-basin.

063568
PRAIRIE PROV WATER BOARD * **Water demand study, Historical and current water uses in the Saskatchewan - Nelson Basin, Appendix 4, Power generation water uses** * vp * Prairie Prov Water Board * 1982.

This study, prepared as a component of the Prairie Provinces Water Board's study of historical and current water use in the Saskatchewan - Nelson Basin, is concerned with historical and current water use for hydroelectric and thermal electric energy generation. The study includes: collection and analysis of water use and energy production data for both hydro and thermal plants for those sub-basins where energy was produced during the period 1951 to present; determination of relationships between energy consumption and other variables such as population and industrial activity in the Basin, as well as the relationship of water use as a function of variables including plant capacity, load factor, thermal efficiency and energy production; discussions of the Basin power grid, provincial inter-ties and their evolution, and the cost effectiveness of alternative methods of energy production including nuclear power; and, discussion of energy exported from and imported into the study area.

063532
PRAIRIE PROV WATER BOARD, ENVIRON CONSIDERATIONS SUBCOMM ON WATER DEMAND * **Water demand study, Historical and current water uses in the Saskatchewan - Nelson Basin, Appendix 6, Environmental considerations** * vp * 1982-10.

This report focuses on the river flow aspects of the environmental considerations for the Saskatchewan - Nelson Basin. A brief overview of the river environment is provided, with emphasis on the effects of regulation on streamflow and the significance of streamflow to wildlife habitat. The data used in this study describes three areas of interrelated concerns: (i) historic and current hydrology and geomorphology relevant to fish and

wildlife habitats and to some instream use, (2) fish and wildlife habitats related to major rivers, creeks, and lakes, and to their immediate surroundings, and (3) water quality of selected rivers and lakes as it is relevant to fish and wildlife habitats and to some instream uses. A description is given of each of eight major river systems in the basin and a summary is given of the degree to which the objectives of the environmental considerations sector study were met. The source documents for this report, prepared by the provincial agencies, are attached as annexes. They provide detailed descriptions of the river corridors, including: geomorphic and hydrologic characteristics of the major tributaries, fish habitat, wildlife habitat, other instream uses of water (transportation), and water quality. The relationship between existing conditions and river discharge is also discussed, in that man-made alterations to the river regimes and the subsequent impacts on habitat are identified.

063569
PRAIRIE PROV WATER BOARD * **Water demand study, Historical and current water uses in the Saskatchewan - Nelson Basin, Main report** * 147p * Prairie Prov Water Board, Motherwell Build, Room 306, 1901 Victoria Ave, Regina, Sask S4P 3R4 * 1982.

In 1976 the Prairie Provinces Water Board initiated a study of the historic and current water uses in the Saskatchewan-Nelson Basin. This Water Demand Study was completed in 1982 at a total cost of $945 000. It serves as a companion to an earlier study completed in 1972 entitled "Water Supply for the Saskatchewan-Nelson Basin." The Water Demand Study deals with municipal, industrial, and agricultural water uses and with instream requirements for energy generation, recreation, and fish and wildlife habitat. Changes in water use between 1951 and 1978 and the factors affecting water use are documented and they indicate that water use is growing at a much faster rate than population. Agricultural water use is the largest net consumptive user of water in the Basin. Some 1.47 million of the 1.69 million cubic decametres used consumptively in 1978 was used for agricultural purposes. The 1.47 million decametres is a 300 percent increase over the 370 000 cubic decametres used for the same purpose in 1951. Hydroelectric energy generation is the largest gross (non-consumptive) user, 410 million cubic decametres in 1978 with only six million cubic decametres being used for all other purposes. Between 1951 and 1978 hydroelectric uses increased from 136 to 410 million cubic decametres, an increase of 200 percent. This study led to several conclusions regarding the collection and analysis of water use data. The major conclusion relates to the importance of maintaining the data base that has been created. The continuing value of this data base for future studies will depend on the steps taken to keep it current and up to date.

063530
PRAIRIE PROV WATER BOARD, MUNIC IND SUBCOMM, COMM ON WATER DEMAND * **Water demand study, Historical and current water uses in the Saskatchewan - Nelson Basin, Appendix 2, Volume 1 of 2, Municipal and industrial water uses** * vp * Prairie Prov Water Board * 1982-12.

This report deals with the municipal and industrial water uses in the 15 sub-basins of the Saskatchewan - Nelson Basin. The emphasis is on water withdrawals for use by large communities and major water using industries, although water usage by small communities, unincorporated settlements and minor industrial water users also are examined. Socio-economic data generated by the "Regional Economic Base Study" (Appendix 1) was related to water use trends to establish relationships and explain the differences that exist among individual municipal and industrial users. Data collection and analysis covers the years 1951, 1956, 1961, 1971, 1976, 1977 and 1978. Various factors affecting water use within the provincial sectors of the basin are outlined. Municipal and industrial water use in the basin is summarized and the conclusions of the study regarding both water use patterns and the major factors affecting water use are presented. Data requirements for future studies, data inadequacies and recommendations relative to data storage and retrieval are discussed. Annexes to the report include the Memorandum of Understanding for the Municipal and Industrial Sector Report, a glossary and the Alberta Agency Report, summarizing municipal and industrial use in Alberta. It also contains monthly and annual pumpage values for large and small communities, details of individual sewage systems, net evaporation values and an individual listing of major industrial water users and their annual consumption, by sub-basin.

063531
PRAIRIE PROV WATER BOARD, RECREATION SUBCOMM, COMM ON WATER DEMAND * **Water demand study, Historical and current water uses in the Saskatchewan - Nelson Basin, Appendix 5, Recreational water uses** * vp * Prairie Prov Water Board * 1982-08.

This study identifies and catalogues all known water-based recreation sites within the Saskatchewan - Nelson Basin. Water quantity and quality problems known to inhibit activities at specific sites are documented to provide an additional dimension to recreation and water supply. The methodology is presented and a basin overview is provided for water-based recreation. The information is organized by sub-basin according to each of the provincial portions of the basin. Topics covered are supply, participation, and water

requirements. User aspects of water-based recreation are examined as well as the underlying factors affecting the demand for recreation. The distribution of sites is discussed by activity, sub-basin, and participation rates, and trends in participation are given by activity and province. Demographic data and participation rates are analyzed. The primary sources of information for this report are detailed reports by Alberta Environment, Saskatchewan Environment, and the Manitoba Department of Natural Resources, which are included as annexes to the report.

062845
SANDERSON K * **Irrigation agriculture in Alberta: summary** (see chapter 8 for complete reference - voir chapitre 8 pour la reference complete)

065923
SMITH DW (COMP) * **Proceedings Third Symposium on Utilities Delivery in Cold Regions, held May 25 and 26, 1982, Edmonton, Alberta** * Econ Tech Rev Rep EPS 3-WP-82-6 * 419p * Environ Can, Environ Prot Serv, Ottawa, Ont K1A 1C8 * 1982-12.

These proceedings describe the development and performance of utilities systems in cold regions. Four status reports on water and sanitation facilities in several sectors of the north, including Alaska and Greenland, comprise the technical program. Systems planning, from the integration with the existing social structure to the economic analysis of alternatives, is described in two papers. The topic of water use reduction through system modifications, water conservation, and design for operation and maintenance, is covered in six papers, with examples supplied from Barrow, Alaska, and the Northwest Territories. The quantity and quality of water, removal of wastes, adequacy of housing and its ventilation, and the design for fire prevention, are addressed in four papers covering public health aspects of living conditions in cold regions. Heating and electrical requirements of northern living are examined in four papers. Solid waste management in cold regions is also discussed. Three case studies, two focusing on Barrow, Alaska, and one on the water supply at Tuktoyaktuk, N.W.T., present information on the design and construction of large-scale municipal facilities.

047402
SURV BRANCH, ALTA RIVER FORECAST CENT * **Water supply outlook and snow survey bulletin, Alberta** * 13p * Alta Environ, Tech Serv Div * 1980-07-01.

The Water Supply Outlook and Snow Survey Bulletin is issued four times each year for March 1, April 1 and June 1. Water Supply updates are also published for July 1 and August 1, with a summary in October. The annual summary is entitled, Water Supply Review and Snow Survey Summary. Each issue of the bulletin reports on mountain snowpack, streamflow, water supply, water storage, precipitation and irrigation conditions for the major river basins.

063773
TATE DM * **Canadian experiences in water demand forecasting since 1970, Chapter 13** , IN: Water problems and policies * SEWELL WRD, BARKER ML * Cornett Occas Pap No 1 * 145-154 * Dep Geogr, Univ Victoria, Victoria, BC V8W 2Y2 * 1980.

This paper is a review of Canadian water use and demand forecasting studies carried out since 1970. Several reasons are given for conducting water demand forecasts and a framework is presented against which water demand studies can be assessed. Some studies which have been completed or are currently underway are assessed and the methodologies of two major on-going investigations are described. The two studies described are the Great Lakes Diversions and Consumptive Uses study and the Prairie Provinces Water Demand Study. Water use and demand studies in Canada have been slow to develop. The overall water abundance of the country is seen as the major explanation for this delay. Applied studies in the past have tended to use the simplistic coefficients approach, with advanced work being conducted principally in the universities. Current studies are beginning to use some of the more theoretically accepted methods.

062294
THOMSON L * **Cottage-plan threatens Winnipeg's water supply** * Civic * 35(3) 43-44, 46 * Maclean Hunter Ltd, Maclean Hunter Build, 777 Bay St, Toronto, Ont M5W 1A7 * 1983-03.

The quality of Winnipeg's water supply would be threatened if the Shoal Lake Indian Band's proposal for a 350 lot cottage development on the shores of Indian Bay were approved. City officials fear that the cottage development and possibly a road to the area will pose an unacceptable risk to the quality of their drinking water and a treatment plant to negate the effects of pollution would take years to build and would cost about $100 million. The City of Winnipeg has insisted on a Federal Environmental Assessment Review Office (FEARO) study before it would join negotiations aimed at having Ottawa, Manitoba, and the city compensate the band for restricting its development rights. To date, the Indian band has failed to submit an environmental impact statement to the FEARO panel, the first step in the process. Recently however, the band agreed to proceed in return for a $45,000 winter employment program funded by the federal government. The

city hopes that the FEARO study will address the important issue of rules and regulations for the present and future protection of its water supply.

4.12 Data Collection Procedures and Processing - Methodes de saisie et traitement des donnees

067080
1983 Annual Conference, June 1-3, 1983, Ottawa, Ontario, Proceedings, Recent developments in computer applications in civil engineering * 190p * Can Soc Civ Eng Comput Appl Div * (1983).

Papers presented dealt with recent developments in computer applications in civil engineering. A report was given on the general aspects of computer systems, including the need for and uses of such systems, and a detailed description was given of a software system being developed by the Province of Ontario for the design and analysis of highway structures. A family of computer programs designed to solve the problems most often addressed by geotechnical engineers were described. The nucleus of the software system is SLOPE-II, which provides 6 different methods of slope analysis and a method of lateral earth force analysis. The development of an interactive computer program for structural analysis, design and drafting was described, and details were given of the TASKMASTER database management system which provides the potential for improving productivity in the design and construction process and in the quality of the final structure. Four computer systems were identified and described that interface with each other in the finite element solutions of engineering problems and the methodology used to derive flow discharge input for sediment computation in the Fraser River network using computers was described. Developments in computational hydraulics systems in civil engineering were reviewed and a description was given of how data bases and graphic systems can be combined to help in the management of municipalities. The development of a digital topographic data acquisition and mapping system was described and the experiences of the Water Resources Branch of Environment Canada in the planning and implementation of a digital data acquisition system were related. A description was also given of MIDUSS, a design program for storm water sewerage.

067083
BOALS RG * **Implementation of a digital data acquisition system for water resources** , IN: Can Soc Civ Eng 1983 Annual Conf, Proc. Recent Developments in Computer Applications in Civil Engineering, June 1-3, Ottawa, Ont * 163-172 * Can Soc Civ Eng, Comp Appl Div * (1983).

The Water Resources Branch of Environment Canada was established in 1908 by the federal government and charged with the task of measuring the quantity of Canada's freshwater resource. Throughout the decades, the Branch has always taken a progressive attitude to the evaluation and implementation of new technology. This spirit continues today as the Branch seeks to ensure its responsibility is carried out in a most effective and efficient manner. In 1982, two events occurred which brought the latest in new technology to the Branch and have lead to major alterations in its activities. Early in that year, the federal Treasury Board approved the purchase of eight minicomputer systems. The second event occurred in August with the Branch receiving authority to acquire and install 350 Data Collection Platforms (DCPs) in remote areas of the country. These systems are being used to sense, store and transmit environmental data from unmanned sites and automatically retrieve, process and interpret the basic hydrometric data. The purpose of this paper is to describe our experience in the planning, selection and implemention of this new technology. The paper emphasizes the need to manage the introduction of new systems particularly from the planning aspect of management. The effects of this new technology on personnel are highlighted.

064635
CARD JR * **Inadequate hydrometric networks, A constraint on knowledge and development** * 17p * Alta Environ, Tech Serv Div, Hydrol Branch, Edmonton, Alta * 1981-06.

The increasing demand for hydrologic data throughout Alberta and its increasing cost of collection have re-emphasized that the collection of hydrologic data must by planned and co-ordinated into a network of steamflow gauging stations that will provide the essential information at a reasonable cost. This report evaluates the adequacy of the existing hydrometric network in Alberta by establishing quantitative preliminary accuracy goals for both the individual stations and for the network as a whole, and by a pilot basin (Oldman River above Lethbridge) to determine if the established goals have been met. The analysis indicates that the hydrometric network for the pilot basin does not have a sufficient number of streamflow stations nor a long enough period of record at these stations to permit the development of accurate equations for transferring information to ungauged sites. The report concludes that the hydrometric network in the rest of the province will also be inadequate.

F10875
CHAU ASY * **Importance des etalons de reference dans la verification de l'exactitude des resultats d'analyses environnementales** (see chapter 4.16.1 for complete reference - voir

chapitre 4.16.1 pour la reference complete)

F10687
FORD JS (ED) * **Prototypes d'appareils pour les etudes et mesures en milieu aquatique, 1981** * 53p * Environ Can, Div hydraul, Inst natl rech eaux, Cent can eaux inter, Burlington, Ont * 1983.

Les conceptions d'appareils decrites dans le present rapport representent le resultat du travail d'une equipe d'ingenieurs specialises dans le materiel destine a obtenir des donnees et des echantillons sur les lacs et les cours d'eau. Comme la liste couvre une vaste gamme de projets en genie mecanique et electronique, elle pourrait s'averer interessante et utile.

063397
FORD JS (ED) * **Prototype designs for surveys and measurement in an aquatic environment, 1980** * Tech Bull No 123 * 79p * Natl Water Res Inst, Inland Waters Dir, Can Cent Inland Waters, Burlington, Ont * 1982.

The designs described in this report are the work of an engineering team which specializes in equipment and instrumentation for obtaining data and samples in lakes and rivers. These designs, which cover a wide range of projects in electronic and mechanical engineering, have been compiled because some of these developments may be of interest and of use to others.

F11618
FORD JS * **Prototypes d'appareils pour les etudes et mesures en milieu aquatique, 1980** * Etude no 123, rapp tech * 79p * Approvision et serv Can, Ottawa, Ont * 1982.

Les dispositifs decrits dans ce rapport ont ete concus par une equipe d'ingenierie qui se specialise dans l'equipement et les instruments utilises pour recueillir des donnees et des echantillons dans les lacs et les rivieres. Les prototypes representes visent a ameliorer l'efficacite de la collecte et de l'enregistrement des parametres relatifs a la qualite de l'eau, de meme qu'a la qualite des mesures physiques. Les specifications techniques ainsi qu'une photographie paraissent pour chacun des modeles presentes.

066165
GOODISON BE, METCALFE JR * **AES Nipher shields for recording precipitation gauges: an assessment** , IN: Proc Thirty-seventh Annual Eastern Snow Conf, June 5-6, 1980, Peterborough, Ont * GOODISON BE * 196-198 * (1980).

This paper briefly describes the design and construction of a "scaled-up" version of a MSC Nipher shield intended for use in areas of low snowfall. Two prototype shields were installed on Fischer and Porter and Universal Belfort recording gauges at the Toronto Meteorological Research Station in January 1979. Measurements obtained during the snow season are summarized by event. Additional shields were built and installed for testing on gauges located in different snowfall environments during the 1979-80 winter season. Results of data from the various locations are discussed and it is suggested that further testing of this type of shielding is warranted.

063795
GOTTINGER R * **Computerized editing of current meter data** * Tech Note Ser 82-2 * 36p * Fish Oceans Can, Oceanogr Div, Ocean Sci Surv, Bayfield Lab Mar Sci Sur, Burlington, Ont * 1982-07.

This report describes a program which provides a means of computerized editing of current speed and direction and salinity and temperature data as collected by a current meter. The current meter time series data is corrected by one-dimensional data smoothing. Routine ICSMOU performing the data smoothing is part of the IMSL library, but may easily be replaced by any other suitable routine. Any insertion or deletion of data has to be done prior to using this program. Two 1976 Hudson Bay current meter files were edited using this program and are presented here as examples. A user's guide and a listing of the Fortran programs are included in the appendices.

066693
GOULTER IC, KIELY DA * **Evaluation of the hydrometric network on the Pembina River through simple statistics** , IN: Third Biennial Plains Aquatic Research Conf, Proc, August 24 and 25, 1983, Montana State Univ, Boxeman, MT * SCOTT MD * Can Plains Proc 11 * 27-44 * Inst Nat Resour, Dep Earth Sci, Montana State Univ and Can Plains Res Cent, Univ Regina * 1983.

Flow statistics for the Pembina River in Manitoba are reviewed to identify any trends which may assist in the evaluation of the existing hydrometric network. Strong linear relationships were found between the logarithms of drainage basin area and the logarithms of the mean, median, standard deviation and range of the annual mean flows. The same relationships were found to exist but to be less distinct for the annual peak flows. Preliminary conclusions indicate that it may be possible to use these relationships to estimate the mean, median, standard deviation and range of annual mean and annual peak flows for ungauged locations in the river system. The results also suggest that hydrometric networks should be designed to ensure that stream gauging stations are located uniformly across the range of drainage areas within a particular watershed.

062384
GREGOR DJ, ONGLEY ED * **Data filtering for large area analysis - an example from the Canadian nearshore zone of the Great Lakes** * J Great Lakes Res * 8(3) 470-481 * 1982.

A problem common to all large area analysis is how to deal with large data sets which have evolved over a period of years. Such data sets often have inconsistent (in time and space) parameters, sampling location, sampling methodology, and analytical procedures. This is the case for the nearshore water quality data for the Canadian Great Lakes which have been collected by the Ontario Ministry of the Environment since 1967. As a result, a methodology has been developed to reduce (filter) the data set to a manageable size and provide a substantive summary of nearshore water quality for the period 1967 to 1973. Initially, the data can be divided temporally to reflect major changes in laboratory techniques and sampling methodology (timeframes). Subsequently, the data base is partitioned into geographical regions reflecting sampling station configurations and subjective criteria regarding expected homogeneous water quality. Surface and subsurface data are distinguished among limnologically defined seasons. Descriptive Statistics are generated for each cell of the 2 x 3 timeframe matrix (rows = surface and subsurface, columns = spring, summer and fall). One and two-way analysis of variance techniques are used to determine Significant Statistics for each timeframe matrix. These are assumed to be conservative estimates of average water quality for a given parameter within a particular region and for specified time periods and depths or combinations thereof. Selected water quality data for Lakes Erie and St. Clair and Lake Ontario, including Toronto and Hamilton Harbours and the Bay of Quinte, are presented and discussed as examples of the usefulness of these data for providing (i) period of record composite comparisons among water bodies; (ii) spatial comparisons within any one time frame and for any selected cell; and, (iii) temporal trends determined by weighted linear regression for a selected cell through the three timeframes. It is concluded that this data base is useful for evaluating broad spatial and temporal trends and assessing the effect of remedial programs, and warrants more comprehensive analysis in conjunction with loadings information and open lake data.

065804
HALLIDAY RA, HYDE W, WYATT WE * **Photovoltaic power systems at Saskatchewan gauging stations** * 8p * Environ Can, Environ Conserv Serv, Inland Waters Dir, West North Reg * 1983-02.

Photovoltaic power systems have been used in Saskatchewan since 1978, when the first was installed at the gauging station on Long Creek near Estevan. Although this installation continued to perform with its original battery for over four years, other subsequent installations at some 50 sites have not been as successful. In general, problems arise with the batteries used rather than with the solar panels themselves. Several different solar panels from two different manufacturers have been used. The panels have been mounted in a number of ways on existing buildings in various parts of the province. In addition many different batteries have been used with the solar panels. In general the batteries power water level servo-manometers or satellite Data Collection Platforms (DCPs). The combinations of site conditions, solar panel battery and instrument are such that each installation could be considered unique. Despite that, certain trends have emerged and it is possible to make recommendations for the future. This report considers system requirements, describes the existing installations, discusses the problems that have emerged, and makes recommendations for the future. The report is based on information and comments provided by hydrometric staff in Saskatchewan.

065334
JAMES W * **Data preprocessing for sensitivity analysis and validation procedures for optimizing model complexity** * 10p * 1981.

Increasingly, sophisticated computer models are being used by specialists. Because of the large variety of programs available, the rapid evolution of the models and their complex structures, studies are becoming increasingly difficult to manage. Input preprocessors can help if the input data file is built to facilitate verification tests and sensitivity analysis. Output, post-processors can aid in calibration and validation procedures. In the model study, the following activities should be specified in detail at the onset: problem review, study objectives, performance criteria, requisite accuracy, review of available programs, available data and study resources, program selection criteria, model verification, model calibration, model validation, minimum level of discretization, sensitivity analysis, data preparation and output interpretation, documentation of the modified program actually used, and preparation of machine readable input and output files for archiving. The models should identify all hydraulically and hydrologically significant elements in the study area so that the model selected can be shown to include all relevant processes. The study objectives should relate the objective functions, viz pollutographs and/or hydrographs, to the design alternatives. The delivery of computer-based engineering design could be improved by the suggestions in the paper; they should reduce the chances of using an inappropriate model, inappropriate use of an otherwise suitable model, such as erroneous data preparation or output interpretation, and ignorance of the model details even when the

results are acceptable. Model complexity will be optimal.

065591
JAMES W, HARO H, ROBINSON MA, HENRY D, KITAI R * **Hydrometeorological data acquisition: innovative, high-resolution programmable instrumentation for stormwater management** (see chapter 4.3 for complete reference - voir chapitre 4.3 pour la reference complete)

067082
JAMES W, UNAL A * **Computational hydraulics systems as distributed data management** , IN: Can Soc Civ Eng 1983 Annual Conf, Proc, Recent Developments in Computer Applications in Civil Engineering, June 1-3, Ottawa, Ont * 129-141 * Can Soc Civ Eng, Comp Appl Div * (1983).

Computational systems in Civil Engineering hydraulics and hydrology include: data acquisition, management, archiving and presentation; documentation and text processing; application programs in meteorology, hydrology, hydraulics, water quality modelling, fluid mechanics, and coastal and ocean engineering; program maintenance and support; and real-time control. Hardware and software systems are undergoing rapid development in all these areas. Emerging techniques make it possible to supplant event modelling and its associated design storm methodology, with more rational continuous modelling using AES archives, statistical processing of output, and graphics I/O. Continuous modelling, however, leads to data management difficulties. Special software for time series management is essential. Sophisticated data base management systems and distributed network disc operating systems permit improved cost performance. The paper recommends a network of desk-top microcomputers with a central hard disk system set up as a single user application of a multi-CPU system. The paper reviews some of these developments and discusses the inevitable evolution of microcomputer-based distributed data management systems for Civil Engineering computational hydraulics and hydrology.

063903
POL RA * **Evaluation of the hydrometric network Labrador-Quebec transboundary river basins** * IWD-AR-83-WRB-41 * 12p * Water Resour Branch, Inland Waters Dir, Atl Reg, Environ Can, Dartmouth, NS * 1983-03.

The data collection network established in Labrador by Federal, Provincial and private agencies was intended to provide streamflow data to meet the design and operation requirements of various development projects, especially hydro-electric power. The purpose of this report is to evaluate the adequacy of this hydrometric network in the Labrador portion of the Labrador-Quebec transboundary river basins. There is a definite need for additional data to help in the planning and management of water resources projects. The type of data required for the various purposes and the agencies involved in the use of the data have been summarized. Eleven hydrometric gaging stations are monitoring flows in the five major transboundary basins. It is recommended that additional stations be placed in the headwaters of the Saint-Augustin River and the Natashquan River.

064200
SASK CO-ORDINATING COMM * **Canada - Saskatchewan, Memorandum of Agreement for water quantity surveys, annual report 1982-1983** * 78p * Sask Coordinating Comm, Regina, Sask * 1983-09.

This eighth annual report summarizes activities and program cost sharing for water quantity surveys in the province of Saskatchewan for fiscal year 1982-83. Highlights of program activities include: the program to install 30 Data Collection Platforms at remote sites over the next five years to begin in late 1983; proposed changes to the current publication format of hydrometric data; initiation of bucket surveys following selected major rain storms; and, possible changes to the hydrometric network, particularly in response to the water supply study of the Frenchman River Basin. The 1982-83 program was completed satisfactorily following greater than normal flows in much of southern Saskatchewan and below normal flows in northern areas. Network expansion was limited during the report period with only one new station being constructed. During 1982-83 the Saskatchewan share of the program was $399 564; the federal share of program costs was $695 580.

066457
SHERA WP * **Using the British Columbia hierarchical watershed coding system to organize basin data** , IN: Acquisition and Utilization of Aquatic Habitat Inventory Information, Proc of a Symposium, 28-30 October, 1981, Portland, OR US * ARMANTROUT NB * 26-31 * Am Fish Soc, West Div * (1982).

A hierarchical numbering system for coding basins has been developed and used to store and retrieve data about the watersheds of British Columbia and the Yukon. The system can be applied across eight levels of basin hierarchy, and used for all information which is geographically associated with a basin.

066657
WHEELOCK AP, CHUBAK JH * **Construction, upgrading & maintenance 1982-83 Annual report** * 50p * Environ Can, Environ Conserv Serv, Inland Waters Dir, West North Reg * 1983-04.

The Saskatchewan District, Water Survey of Canada carries out construction, upgrading,

and maintenance of hydrometric gauging stations with in-house forces. Contractors are hired for special portions of the work such as excavation, backfill, loading and hauling of rocks and gravel, transit mix concrete, dragline work and other specialized tasks. Extensive use is made of prefabrication techniques and bulk purchases of construction supplies to reduce program costs and minimize field labour time. Installations of stilling wells and walk-in instrument shelters are standardized to a large degree. Cableways and artificial controls are individually designed as dictated by site conditions. The construction program is divided into three parts, construction - "C", upgrading - "U" and maintenance - "M". The definitions for "C-U-M" have been changed significantly from past years. The new definitions are closer to those used in other offices and will facilitate comparison of statistical information. The new definitions are as follows: Construction - "C" - a new gauging station requiring a new station number. Upgrading - "U" - the addition of facilities to existing stations that significantly improve the quality or type of record produced or that facilitate the collection of data. Generally any major renovations such as the following: - change in operation from manual to automatic with new or additional equipment. - conversion of california type to walk-in shelter - the addition of a steel or concrete weir.

4.13 Hydro Development - Mise en valeur hydroelectrique

065059
ACRES CONSULT SERV LTD, CALGARY, ALTA * **Slave River Hydro Power Project, Feasibility Study, Task Area Two, Volume I Main report, Volume II Appendices A-D, Volume III Appendix E** * vp * 1982-04.

This is the final report of Task Area Two - Power System Studies of the Feasibility Study for the Slave River Hydro Project. Volume I covers all areas of Task Area Two studies for phases I and II of the Slave River studies. Volume II covers the backup material for the economic analysis detailed in the main report. The details of the financial analysis and the financial model results are presented in Volume III. In Volume I load forecasts are presented and generation supply alternatives are discussed. Operational assumptions are listed and characteristics of the Slave River Project are described. Economic parameters involved are discussed as well as planning criteria. Environmental and social considerations are reviewed and system study results are presented. A financial analysis is presented and service to the Northwest Territories is discussed. In the appendices a summary is given of the results of the preliminary forecast of the electric energy requirement, load factor and peak demand for Alberta Interconnected System.

066838
BARNHART GA (ED) * **Hydropower and fisheries: impacts and opportunities, Proceedings of the 1982 Northeastern Division American Fisheries Society Coldwater workshop, June 15 through June 17, 1982 at Cornell University, Ithaca, New York** * 127 * New York State/Dep Environ Conserv, NY, USA * (1982).

The proceedings are composed of papers focusing on hydropower development and regulation, hydropower impacts and assessment techniques, and opportunities for fishery enhancement. Papers deal with governmental roles in hydropower development, impacts on fish passages, effects of flow regulation and water quality on trout, and fisheries and recreational development from hydropower projects. A panel discussion of two hypothetical case histories concerning hydropower projects is included.

F10887
BAXTER RM, GLAUDE P * **Les effets des barrages et des retenues d'eau sur l'environnement au Canada: experience et perspectives d'avenir** * Bull can sci halieut aquat no 205F * 36p * Minist Peches Oceans, Dir inf et publ sci, Ottawa, Ont * 1980.

Les auteurs de ce rapport examinent les consequences ecologiques de la construction des barrages et de la retenue des eaux au Canada et signalent aux specialistes de l'environnement et aux ingenieurs les problemes qui peuvent etre inherents a de telles activites. Apres une description des types de barrages, on aborde les consequences generales geographiques, physiques, chimiques et biologiques de la construction d'un barrage, autant en amont qu'en aval; puis on traite de leur mode d'action tres complexe sur les populations de poissons. Enfin, on aborde certains des effets qui peuvent etre ressentis dans le voisinage des barrages et retenues d'eau et qui ne sont pas necessairement limites au nouveau lac ou cours d'eau.

066187
BC HYDRO, PUBLIC AFF * **Stikine-Iskut hydroelectric development, Progress report on feasibility studies** * vp * BC Hydro * 1980-12.

This report describes the progress of preliminary investigations conducted by B.C. Hydro of the engineering, economic and environmental feasibility of potential hydroelectric sites on the Stikine and Iskut rivers. The development plan being considered envisages two damsites on the Stikine River and two in the Iskut basin as well as a diversion dam on Forrest Kerr Creek to provide additional water for generation. Data are presented on the individual projects, the

locations of the proposed developments are shown and the river profiles with project locations are given. Consideration is also given to the transmission system that would be required and to the regulatory statutes which would govern the project. The possible impacts of the project on the physical, biological, social and economic environments are discussed in detail. From studies carried out in 1978 and 1979 it is evident that hydroelectric development of the Stikine and Iskut rivers and integration into the provincial grid are technically feasible and economically attractive.

062633
BEAK CONSULT LTD, ATL DIV * **Cat Arm hydroelectric project, Environmental impact assessment, Fisheries resource study** * vp * Beak Consult Ltd, Atl Div, P O Box 367, St John's, Nfld A1C 5J9 * 1980-07.

This study of the Cat Arm power development on the Great Northern Peninsula, Newfoundland was carried out in the autumn of 1979. The report describes the project, energy structures, power structures, the operation of the reservoir, and the environmental setting. It discusses the physiography, geology, climate, hydrology, morphometry of lakes and ponds, water quality, and bio-limnology of the study area. The area is in a pristine state. Productivity of all biological systems is extremely low. The system is estimated to contain 37,000 units of good salmonid rearing habitat in streams; however, only about 100 units is accessible to anadromous fish. Resident brook trout in good stream habitat in the upper part of the system occur in low densities, are slow growing and short lived. Small waterfalls divide the trout into several semi-isolated populations. The potential for a sport fishery resource is believed low. The project will have substantial impact on the hydrology, limnology and fisheries of the study area. Dewatering will occur in the Cat Arm River, and runs of anadromous salmonids will be reduced while Atlantic salmon may be eliminated from the river. The reservoir has a potential yield of fish of 1.8 kg/ha/yr, exceeding the yield of present ponds. Flooding may result in the loss of 2200 ha of good trout rearing habitat and may affect the success of reservoir spawning. Mitigation measures such as stocking, introducing a forage species of fish, and cleaning the reservoir will attempt to preserve the downstream anadromous salmonid populations and offset the limiting factors for reservoir populations. Monitoring is recommended to provide information for implementing contingency plans for mitigation. Figures show the distribution of salmonid rearing habitats and growth rates for populations of brook trout. Appendices give a description of aquatic resources, terms of reference, and survey methods.

062635
BEAK CONSULT LTD, ATL DIV * **Cat Arm hydroelectric project, Environmental impact assessment, Fisheries resource study, Addendum: Anadromous trout study** * vp * Beak Consult Ltd, Atl Div, P O Box 367, St John's, Nfld A1C 5J9 * 1980-12.

This study, completed in the autumn of 1980, investigated the anadromous fish populations of the Cat Arm River system on the Great Northern Peninsula, Newfoundland. The pool below the barrier falls, the river between the pool and the estuary, and the estuary proper are identified as key areas to be impacted by hydroelectric development. A netting program is conducted in the estuary using a trap net, hoop net, and gill net. The river habitat is sampled using standard electrofishing techniques, and angling is employed in all habitats. A surveying program is employed to investigate the morphometry and hydrology of the habitat. There appears to be a sizeable population of sea trout and a residual population of Atlantic salmon utilizing the lower Cat Arm River. Trout populations are estimated to be from 200-400 individuals (greater than 150 mm in length). The river habitat and the estuary are key areas in the production of juvenile salmonids; however, the estuary plays a significant role in the early life stages of the sea trout and salmonids. Present recreational use of the fishery resource is almost non-existent. The Cat Arm River contribution to the commercial fishery even at maximum potential would be extremely small. Two mitigation approaches are examined. Riparian releases over the dam are considered economically unfeasible. The possibility of salvaging some of the river habitat in the lower river by concentrating recovery flows in one of two available channels would involve construction of a dam. It is felt this approach would not prove cost effective.

061864
BERKES F * **Preliminary impacts of the James Bay hydroelectric project, Quebec, on estuarine fish and fisheries** * Arctic * 35(4) 524-530 * 1982-12.

Flow alterations related to hydroelectric development have affected both the fish stocks and the Cree Indian subsistence fishery in the lower LaGrande River, northern Quebec. Evaluated against several years of baseline data, the initial biological impact of the project on fish populations, mostly whitefish (Coregonus clupeaformis) and cisco (C. artedii), appeared to be relatively small. Nevertheless, fishing activity in the lower river and the estuary largely ceased from 1979 to 1981, due to physical modifications of traditional fishing areas and other social and economic effects related to the hydro project. Some fishermen modified their methods and continued harvesting in the affected area, but others abandoned the affected area and fished

lakes and rivers along the recently constructed road network. It is concluded that earlier impact assessments fell short of predicting tnese impacts.

F10945
BOUCHER R, LEMIRE R * **Description generale du bassin de la riviere Desaulniers et des stations echantillonnees en 1976, 1977 et 1978** (see chapter 2 for complete reference - voir chapitre 2 pour la reference complete)

F10566
DEMERS JJ * **Repertoire des etudes des rivieres du Quebec, 7 volumes** * Pd * Hydro-Que, Montreal, Que * 1981.

Le but du present repertoire est, en premier lieu, de faire le point sur l'etat des etudes d'amenagement des rivieres du Quebec pour fins de production d'energie electrique ou de regularisation, et, en deuxieme lieu, d'evaluer l'ordre de grandeur du potentiel amenageable de chaque riviere. Ce repertoire en 7 volumes couvre le travail fait entre 1970 et la fin de 1980. Ces volumes sont revises annuellement pour y inclure de nouvelles donnees et l'evaluation preliminaire du potentiel exploitable en cours. Les regions hydrographiques du Quebec servent de base de classification. L'index alphabetique des rivieres permet de retracer la region dont elle fait partie. En premiere page du dossier de chaque riviere est fournie une description qui comprend: etat des etudes, donnees caracteristiques recentes ainsi que la meilleure estimation du potentiel a date. Les pages suivantes contiennent une liste de references pertinentes ainsi que quelques remarques explicatives.

062962
EVERITT RR, BUNNELL P, CARRUTHERS AB, JONES ML, SONNTAG NC * **Liard River hydroelectric development, Application of adaptive environmental assessment and management to planning of the Mackenzie Delta environmental studies** * 199p * ESSA Environ Soc Syst Anal Ltd * 1982-12-14.

This report is a summary of workshops on the application of adaptive environmental assessment and management to the planning of research and analysis of the Mackenzie Delta environmental studies. A description is given of the model and its results, and a synthesis and analysis of the research questions. The ultimate purpose of the proposed project was the development of a framework to be used as a basis for assessing the impacts of the Liard River development on the Mackenzie Delta. The model provides a mechanism whereby the results from individual study areas may be extrapolated to the entire delta. It also provides a way of integrating the information gathered by the various study components: hydrology, vegetation, wildlife, socio-economic, and aquatic biology. The model structure is described in detail and simulation results are presented. The process of building the simulation model revealed gaps in conceptual understanding and lack of data upon which to base the model. These deficiencies are examined in light of current understanding of the biophysical and socio-economic processes of the Mackenzie Delta. Major research recommendations identified in the workshops are listed.

F11732
GORDON G, KEIFER W * **Un equilibre precaire, fascicule modulaire de la chimie de l'energie et de l'environnement** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

065841
GOV ALBERTA, STEERING COMM (FOR SLAVE RIVER HYDRO FEASIBILITY STUD) * **Slave River Hydro feasibility study, synopsis** * 41p * 1982-06.

The Slave River hydroelectric project feasibility study was carried out, under an Alberta Government Cabinet directive, by a Steering Committee, the Chairman of which was the Deputy Minister of Alberta Environment. Technical guidance was received from the Slave River Hydro Committee, consisting of representatives from the Alberta Government and the Alberta Electric Utilities Planning Council. This report, prepared by RL Walker & Partners Limited, is a synopsis of the many detailed reports of all aspects of this multi-disciplinary study that have been prepared by specialist consultants. The purpose of this feasibility study was to determine if one or more hydroelectric projects on the Slave River are technically feasible and economically attractive, having regard to their probable ecoromic, environmental, community and social impacts. The methodology has been to compare systems with and without the project. If the hydroelectric project does not proceed, electric supplies must be developed elsewhere, probably from coal-fired thermal power plants. Between Fitzgerald and Fort Smith are several locations where a hydroelectric development could be constructed. Only sites at Mountain Rapids, Rapids of the Drowned, and an intermediate site designated Alternative 4, are considered economically attractive. This report discusses the intake and powerhouse structure, the spillway, the embankment, the transmission line, and project construction, commissioning and operation. The study has sought to identify the major environmental issues of concern and to describe their effects in general terms.

065768
GRYGIER JC, STEDINGER JR * **Algorithms for optimizing hydropower system operation** (see chapter 4.5 for complete reference - voir

chapitre 4.5 pour la reference complete)

065150
HYDRO-QUEBEC * **Grande Baleine complex, Preliminary report on feasibility studies** * 4v * Hydro-Quebec * 1980-11.

The preliminary report on feasibility studies for the Grande Baleine complex comprises four detailed volumes: Volume 1 is devoted to the development options. Volumes 2 and 3 deal respectively with the means of access to the complex and the drinking water supply for the town of Great Whale. Volume 4 defines the policies concerning the hiring of native labor and corrective measures. Each of these volumes has a summary, which is published separately.

066629
LEE YJ, KVARV E * **Assessment of log debris using LANDSAT MSS data at Williston Lake, British Columbia** * Can J Remote Sensing * 9(2) 111-124 * Can Aeronautics Space Inst, Ottawa, Ont * 1983-12.

Williston Lake is one of several man-made hydro-electric reservoirs in northern British Columbia. Trees covering the projected lake bottom were cut and left lying in 1967. Flooding of the lake, completed in 1971, resulted in a large accumulation of log debris on the lake surface. Assessments of this debris volume have been carried out from time to time to provide volume statistics for long-range disposal planning. The purpose of this study was to determine if digital analysis of LANDSAT data would be useful in measuring changes in debris area and volume. Ground truth for debris area statistics was obtained from high altitude aerial photographs, taken by BC Government King-Air Beechcraft, flying at a height of 6,100 m above lake level. Ground truth for debris volume was obtained from large-scale aerial photographs taken from a low-flying helicopter. Debris area statistics estimated from LANDSAT pixel count were within 12, 84 and 7% of ground truth with ARIES and 9, 82 and 9% with GEMS, for three test sites. Total floating debris volume statistics were within 1.5, 140.2 and - 5.9% of ground truth and 9.4, 34.4 and 12.0% with test site areas adjusted to equal ground truth for the ARIES supervised classification of areas of the three sites; - 2.4, 119.9 and -6.0% and 13, 21.3 and 12.2% for the ARIES unsupervised classification; and 3.9, 167.5 and -9.9% and 0.7, 46.2 and 16.9% for the GEMS digital analysis.

064965
MACLAREN PLANSEARCH, GUARDIAN BUILD, SUITE 608, 10240-124 STREET, EDMONTON, ALTA T5N 3W6 * **Slave River Hydro Feasibility Study, Environmental implications within Saskatchewan** * vp * Alta Environ, Plann Div * 1982-03-26.

This report focuses on Saskatchewan concerns about increased Lake Athabasca levels as a result of a dam on the Slave River. Two overall conclusions are drawn from this study. First, there are a number of valid concerns (issues) in the context of the proposed lake level changes for all scenarios. Second, there is very little scientific documentation to describe any of the concerns. In order to quantify environmental impacts and propose detailed mitigation measures, baseline studies are required. The primary areas of concern in this study are water quality, lake surface use, shoreline uses, fisheries, wildlife, groundwater and vegetation, heritage resources, and proposed future projects.

F10368
MAINGUY G, PIGEON R * **Les energies nouvelles** * Ressources Que * 4(2) 9-15 * Dir commun, Minist Energ et ressources, Quebec, Que * 1980.

La perception, parfois vague mais de plus en plus repandue chez les Quebecois, que le secteur de l energie comporte un defi a relever, a eu pour effet de susciter un reel interet pour l'utilisation de nouvelles sources d'energie: le soleil (energie solaire), le vent (energie eolienne), l'eau (energie des vagues et des marees), la terre (energie geothermique), la tourbe, la foret, les residus agricoles et les dechets municipaux (constituant l'energie des biomasses)... et peut-etre d'autres ressources encore a decouvrir dans la nature. En l'an 2000, on prevoit que cinq pour cent de nos besoins seront satisfaits par les energies nouvelles.

062884
MARTINI IP (ED) * **James and Hudson Symposium, University of Guelph, Guelph, Ont, April 28-30, 1981, Scientific Studies on Hudson and James Bay II** * Nat Can * 109(4) 677-1019 * 1982.

Thirty-two selected papers presented at the James and Hudson Bay Symposium are included in five categories: physical oceanography; marine ecology; environmental impact of hydroelectric projects; wildlife biology; and, human ecology. The physical oceanography papers examine oceanographic research in the area, mean and tidal circulation, time variability of oceanographic parameters, and spring-neap variation. The marine ecology papers cover the macrobenthic fauna, phytoplankton stocks and primary productivity, the larval and juvenile fish community and aperiodic changes of water column stability in an arctic coastal embayment, in the two areas mentioned. Five papers discuss the environmental impact of hydroelectric projects in the area. Wildlife biology is described, focusing on seabirds, lesser snow geese and other geese, polar bears and caribou. The human ecology papers examine Cree psychological adaptation to culture changes,

northern development planning, screening tests among Indian children, community decision making, culture, man - environment research, and energy subsidies and native domestic fisheries.

F10953
NAULT R * **Remplissage du reservoir de LG 2** (see chapter 4.5 for complete reference - voir chapitre 4.5 pour la reference complete)

062626
NEWFOUNDLAND & LABRADOR HYDRO, ENVIRON SERV DEP * **Cat Arm hydroelectric development, Environment impact statement, Addendum** * vp * Newfoundland & Labrador Hydro, Environ Serv Dep, 5th Floor, Philip Place, St John's, Nfld * 1981-03.

This addendum contains additional information and items of clarification on the environmental impact of the proposed Cat Arm Hydroelectric Development located on the Great Northern Peninsula, Newfoundland. It provides information on: the routing and construction of all access roads (including alternatives), transmission line routing (including alternatives) and construction, and location and establishment of major camps and other accommodation. It discusses the potential use of these facilities by the local population. An analysis of the Island's future energy needs is made and the study concludes that the Cat Arm Development is the preferred solution. The report discusses alternative methods of access for the maintenance of the Cat Arm River Dam and Spillway, other than permanent access roads. It concludes that the roads are the most feasible means of access and should not hamper big game activities in the area. It is felt that the effect of the project on caribou and wilderness use is minimal. Its effect on potential use will be to open presently inaccessible areas for low density recreation activities. The report supplies the archaeological information on research strategy, areas surveyed, recommendations for future work, and conclusions based on present findings. Mercury is found to leach from newly flooded rocks at a rate greater than the natural weathering processes. The report sets forth a sampling program to be carried out in the reservoir. The impacts of reservoir drawdown are discussed, including the impact on suspected spawning of brook trout. The report defends the use of Ryder's Morphoedaphic Index as a useful method for projecting potential fish yield in the reservoir. It discusses impact on forests, other vegetation, and wetlands in the study area. Mitigation measures are presented; these should minimize local disturbances during construction of access roads. The report contains Newfoundland & Larbrador Hydro views on which mitigation measures and what future studies and projects should be undertaken.

066042
NFLD AND LABRADOR HYDRO, ENVIRON SERV DEP * **Environmental information report (1981): The Upper Salmon hydroelectric development** * 70p * Nfld and Labrador Hydro, Environ Serv Dep, 5th Floor, Phillip Place, St John's, Nfld * 1981-05.

Newfundland and Labrador Hydro prepared and submitted an Environmental Impact Statement (EIS) in April, 1980 as part of the documentation associated with the Upper Salmon Hydroelectric project. The Provincial Department of Consumer Affairs and Environment felt, however, that greater detail should be provided on the proposed program of mitigation that had been described in the original submission. This, the resulting environmental information report, therefore, serves as a supplementary document to the original EIS. The EIS identified the creation of potential barriers to caribou movements by various components of the project and loss of salmonid habitat and reduction in fish populations as the major negative impacts of the project. This document expands upon the mitigating measures outlined in the initial EIS. These measures include: access roads; channel improvements and reservoir preparation; design and operation changes; construction restriction, and; preventative measures and cleanup. Recommendation for continued monitoring and research activities are outlined in detail.

062629
NORTHLAND ASSOC LTD, ENVIRON & RENEWABLE RESOUR CONSULT & ATL BIOL SERV LTD * **Proposed Dry Pond Brook hydroelectric development, Environmental preview report** * 153p * Northland Assoc Ltd, Environ & Renewable Resour Consult & Atl Biol Serv Ltd, St John's, Nfld * 1980-05.

This environmental preview report is a synthesis of data obtained from published literature, government reports, and interviews. It provides a description of the environment as it exists prior to the proposed development and it describes the impact that may be anticipated. The study area is located in the southern part of Newfoundland, and the entire development covers an area of about 6 kilometres wide by 30 kilometers long. Landforms are described and sensitive areas identified. Fish species present within the area are: Atlantic salmon, and brook trout. The most significant potential impact will be on the Atlantic salmon population of Grandy Brook. Wildlife distribution of: waterfowl, raptors, upland small game, furbearers, and big game is discussed and mitigation measures suggested. Land capability for forestry, wildlife, and recreation is discussed and illustrated. The report concludes that a complete environmental impact study encompassing all components of the study area environment is not necessary. However, the acceptability of the project from an

environmental point of view will be contingent on the outcome of investigations on the impact on moose and caribou populations during the construction phase; and on the magnitude of the impact on the Atlantic salmon populations of Grandy Brook.

064938
NORTHWEST HYDRAUL CONSULT LTD * **Slave River Hydro Project Feasibility Study, Task Area 4 Region B, Hydrological assessments** * vp * 1982-02.

In connection with the proposed hydro-electric dam at Smith Rapids on the Slave River, this report covers the hydrological assessment of the environmental studies for Task Area 4, Study Region B, Lake Athabasca and the Peace-Athabasca Delta. It describes the hydrological regime of the lake and delta under present conditions and under three hypothetical dam operating scenarios (S1, S2 and S3). The overall differences between the three scenarios are small. Scenario S3 would have the least effect on the lake/delta complex. Annual maximum water levels would be higher than present by up to 1.0 m, but extreme annual maximums would be virtually identical to present levels. Annual minimum levels would be similar to present. Scenario S1 would result in slightly more changes than Scenario S3. Scenario S2 would have the greatest effect on the lake/delta complex: annual maximums would be up to 1.2 m higher than present, annual minimums up to 0.8 m higher than present and Athabasca River water would regularly travel farther east into Lake Athabasca in the early winter than occurs at present, resulting in some deposition of silt size sediments over an area of the lake that presently does not experience regular sedimentation.

064933
REID CROWTHER PARTNERS LTD * **Slave River Hydro Project Feasibility Study, Task Area 4, Environmental studies, Regions C and D, Volume 1 to Volume 4** * vp * 1982.

This report presents the findings of a feasibility study to examine several dam sites and operating strategy options for the Slave River Hydro project. Descriptions are given of the study area and of the methodology of the study. Hydroelectric projects and their enviromental effect are discussed and alternative dam sites are described. Present conditions in the study area are described in detail including: hydrological conditions, geology and soils, groundwater, vegetation, wildlife, limnology, water quality, fisheries, and land use. The environmental effects of project construction and operation are discussed, including hydrological and general effects of dam construction and reservoir creation. Enhancement and mitigation opportunities in both the dam construction and reservoir creation phase and the operation and maintenance phase are discussed as well as adverse effects that cannot be mitigated. Volumes 2 to 4 of this report are appendices containing the individual reports of the specialist consultant companies dealing with hydrology, geology and soils, groundwater, vegetation, wildlife, limnology/water quality, fisheries, and land use.

066112
RUSSELL SOD * **Small hydro in British Columbia** , IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * v2 967-976 * Can Soc Civ Eng * (1981).

In British Columbia there are many isolated communities where the electricity is generated by diesel generators. Given the steep topography, the ample precipitation and the rising price of diesel fuel, there would seem to be many opportunities for small hydro electric plants in British Columbia. However, there are some technical and organizational problems that will have to be overcome before the full potential of small hydro can be exploited. These are discussed in the paper.

F10973
SCHETAGNE R * **Influence des mises en eau du Complexe La Grande sur la teneur en mercure dans les poissons** * 15p * Soc energie de la Baie James, Montreal, Que * 1982-10.

La Societe d'energie de la Baie James, desireuse de connaitre l'effet de l'apport potentiel en mercure du remaniement des materiaux necessaires a l'erection des digues de barrages, a entrepris, en 1978, une campagne d'echantillonnage visant a etablir les teneurs naturelles de mercure chez les poissons des regions de LG 2 et d'Opinaca. Quatre especes de poissons, consommes par les autochtones ont ete preleves dans quatre milieux differents. Une campagne exploratoire a egalement ete realisee en 1981 aux reservoirs de LG2 (mise en eau en 1979) et d'Opinaca (inondee en 1980). Deux especes ont ete etudiees: le dore et le grand corégone. Ce rapport presente des elements de comparaison entre les mesures obtenues en 1981 et celles obtenues dans des conditions naturelles.

064923
SHAWINIGAN STANLEY * **Slave River Hydro Feasibility Study, Project Design, Task Area 1, Main report - Volume 1 and Volume 2** * vp * 1982-02.

In this two volume report a summary is given of Task Area 1 studies, Project Design, under the Slave River Hydro Feasibility Study. The studies included the identification and engineering assessment of alternative potential hydro sites on the Slave River in the reach between Fitzgerald and Fort Smith. An overview is given of the alternative sites, and detailed descriptions are given of the

geology, hydrology, river hydraulics, levels, and flow associated with the project. The parameters of the project are outlined and a detailed description is given of Alternative 4. Construction details are presented and estimates are given for capital costs and operation and maintenance costs. Separate appendix volumes cover the following areas: cost estimates, hydrology, modelling and simulations, site information, geotechnical studies and drawings.

064922
SHAWINIGAN STANLEY * **Slave River Hydro Feasibility Study, Project design studies, Appendix A to Appendix I** * vp * 1982-02.

This volume is an appendix to the report which covers the Task Area 1 studies, Project Design, under the Slave River Hydro Feasibility Study. The project design studies consisted of the identification and engineering assessment of alternative potential hydro sites on the Slave River. The main volume of the report summarizes all aspects of the study program. Separate appendix volumes cover the following areas: A - cost estimates, B - hydrology, C - modelling and simulations, D - site information, E - construction materials, F - geophysical surveys, G - Reservoir Integrity Study, H - geotechnical studies, I - the Rochers control structure and drawings. In general the appendix volumes provide background information or data, methods and procedures.

064937
SLAVE RIVER STEERING COMM * **Slave River Hydro Feasibility Study, Final report** * vp * 1982-07.

This feasibility study of a hydroelectric development on the Slave River was initiated by a Cabinet directive in 1978, establishing the Slave River Hydro Feasibility Study Steering Committee to direct the work on behalf of the Government. The purpose of the study has been to determine if one or more alternative hydroelectric projects on the Slave River are technically feasible and economically attractive in light of the probable economic, environmental, community and social impacts. Since there is no proponent for development, the study has been designed to illustrate the range of alternatives which are feasible rather than to identify a preferred scheme. The study has confirmed that a single stage hydroelectric project constructed at any one of three possible sites on the Slave River would be technically feasible and could provide an economically attractive source of electric energy for Alberta. The study has also confirmed that appropriate transmission facilities to interconnect the power plant with the Alberta electric supply system could be constructed and operated satisfactorily. Several alternative routes for the transmission lines are technically feasible, including one which would cross land entirely under provincial jurisdiction.

065806
SLAVE RIVER STEERING COMM * **Slave River hydro feasibility study, final report** * vp * Alta Environ, 14th Floor, Oxbridge Place, 9820 - 106 St, Edmonton, Alta T5K 2J6 * 1982-07.

A study was conducted to determine if one or more alternative hydroelectric projects on the Slave River are technically feasible and economically attractive in light of the probable economic, environmental, community and social impacts. The study confirms that a single stage hydroelectric project constructed at any one of three possible sites would be technically feasible and could provide an economically attractive source of electric energy for Alberta. The study also confirms that appropriate transmission facilities to interconnect the power plant with the Alberta electric supply system could be constructed. The locations of the best three sites are described and comparative data are presented for these alternative sites. The benefits of a Slave River hydroelectric project are evaluated by comparing long-term capital and operating costs of electric supply to Alberta with and without the project, and the economic and community implications of the project are examined. The study also considered a wide range of potential environmental implication of constructing facilities, most of which could be mitigated by adoption of appropriate design features, construction practices or operating procedures.

064928
STANLEY ASSOC ENG LTD * **Slave River Hydro Feasibility Study, Task Area 4B, Surface water quality of the Peace - Athabasca Delta** * 23p * 1982-03.

This is the final assessment report on the quality of surface waters in the Lake Claire-Lake Mamawi and Lake Athabasca drainage systems, as part of the Slave River Hydro Feasibility Study. A description is given of existing water quality based on historical and field data. Details are given of the physical and chemical characteristics of the Lake Athabasca and the Lake Claire-Lake Mamawi drainage systems. The potential changes in water quality associated with alternative scenarios are evaluated on hydrological characteristics of the scenarios provided by other Task Area members. The evaluation revealed Scenario S3 as the preferred alternative because it exhibits less inundation of vegetated areas of the delta.

064929
STANLEY ASSOC ENG LTD * **Slave River Hydro Feasibility Study, Task Area 4B, Environmental studies, Synthesis report** * vp * 1982-04.

This report reviews environmental studies related to the Slave River Hydro Feasibility Study. A description is given of the study area and background hydrologic information is presented including water movement and sedimentation in Lake Athabasca and ice and wind effects on hydrology. Water quality in the vicinity is described under the headings: nutrients, nitrogen, phosphorus, and heavy metals. The fisheries and aquatic fauna are also described. A discussion of the terrestrial systems includes soils and geology, vegetation and wildlife. Existing land use is reviewed and an assessment made of hydrologic scenarios. The methodology used to predict impacts for vegetation and wildlife is outlined and assessments are made of several hydrologic scenarios. Impacts associated with the projected existing hydrology are examined and a comparison is made of impacts for all scenarios and directions for mitigation are suggested.

066077
THOMPSTONE RM, BOUCHARD S, PILON PJ, BERGERON R * **Real-time daily hydrological forecasting for a multi-reservoir hydroelectric system** (see chapter 4.5 for complete reference - voir chapitre 4.5 pour la reference complete)

066975
TURGEON A * **Optimal short-term scheduling of hydroplants in series - a review** (see chapter 4.5 for complete reference - voir chapitre 4.5 pour la reference complete)

062277
UNNY TE, DIVI R, HINTON B, ROBERT A * **A model for real-time operation of a large multi-reservoir hydroelectric system** (see chapter 4.5 for complete reference - voir chapitre 4.5 pour la reference complete)

062283
UNNY TE, MCBEAN EA (ED) * **International Symposium on Real-time Operation of Hydrosystems, June 24-26, 1981, University of Waterloo, Waterloo, Ontario, Canada Proceedings, 2 vol.** (see chapter 4.5 for complete reference - voir chapitre 4.5 pour la reference complete)

4.14 International, Transboundary - Questions internationales, transfrontieres

065359
DREISZIGER NF * **International water management in Canadian - American relations, 1894 - 1907** (see chapter 1 for complete reference - voir chapitre 1 pour la reference complete)

067187
FAHY V * **Trans boundary relations** , IN: Third Biennial Plains Aquatic Research Conf, Proc, August 24 and 25, 1983, Montana State Univ, Bozeman, MT * SCOTT MD * Can Plains Proc 11 * 229-233 * Inst Nat Resour, Dep Earth Sci, Montana State Univ and Can Plains Res Cent, Univ Regina * 1983.

In spite of many geographic and cultural similarities between citizens of the prairie provinces and states, government agencies tend to polarize differences when trans-boundary disputes arise. Local governments on both sides of the border attempted to solve flooding problems of the Pembina River in different ways, which led to recurring controversy. When the International Joint Commission (IJC) declined to review the problem, states and provinces formed committees to work toward a solution. This has culminated in the recent creation of the North Dakota-Saskatchewan Boundary Advisory Committee, which is made up of legislative and executive officials. It is hoped that similar arrangements can be made between Manitoba and North Dakota. The Committee's function is to improve communication and prevent escalation of controversies to federal levels.

067197
INT LAW ASSOC * **Report of the sixtieth Conference held at Montreal, August 29th, 1982, to September 4th, 1982** * 701p * Int Law Assoc, 3 Paper Build, The Temple, London, EC4 7EU, GB * 1983.

The 606 participants and 159 guests attending this conference were from 66 countries. This volume contains the texts of the 13 substantive Resolutions adopted by the Conference, relating to: Collisions at Sea; Legal Aspects of the Conservation of the Environment; Legal Aspects of a New International Economic Order; International Monetary Law; International Commercial Arbitration; State Immunity; International Criminal Law; Space Law; International Water Resources and Air Law. A Committee Report and a report of the working session are included for each of the Working Programmes, which were on the Exclusive Economic Zone, International Terrorism, and International Medical and Humanitarian Law, as well as on the subjects of the Resolutions adopted by the Conference.

067188
LANE RK * **Policies related to transboundary water issues: a Canadian perspective** , IN: Third Biennial Plains Aquatic Research Conf, Proc, August 24 and 25, 1983, Montana State Univ, Bozeman, MT * SCOTT MD * Can Plains Proc 11 * p235 * Inst Nat Resour, Dep Earth Sci, Montana State Univ and Can Plains Res Cent, Univ Regina * 1983.

On the Great Plains, Canada and the United States share portions of two major drainage basins: the Missouri River Basin and the

Saskatchewan-Nelson Basin. The interruption of natural basin boundary configurations by a straight political boundary line has presented some interesting problems. Surface and groundwater movements generally continue to follow natural patterns, though they are now regulated in many ways on both sides of the international border. To date, no artificial disruption of the major basin boundary has occurred. Water management issues of the day are a mixture of old (e.g. Milk River apportionment), recent (e.g. Poplar River thermal power plant), and potential (e.g. water export). In Canada, management decisions are guided by policies at a variety of levels. Perhaps the most fundamental is the policy regarding observance of the Boundary Waters Treaty of 1909. Since 1912, Canada has agreed with the United States on the issuance of 61 Applications and 48 References to the International Joint Commission. Other policies relate to federal/provincial activities and relationships, to industrial development, water development projects, and environmental assessment procedures. Of particular recent interest are two "pillar" policies of Environment Canada: an Environmental Quality Policy, and an Environmental Conservation Policy. A new federal water stragegy is expected to be announced in mid-1983. The status of provincial policies is mixed. Alberta has published a policy statement, but Saskatchewan and Manitoba have not produced formal consolidated policy documents. The implications of formal policies and those that can be inferred, are discussed in the context of foreseeable issues.

067186
MACLEOD DL * **Management of international streams - a Saskatchewan perspective** . IN: Third Biennial Plains Aquatic Research Conf, Proc, August 24 and 25, 1983, Montana State Univ, Bozeman, MT * SCOTT MD * Can Plains Proc 11 * 223-227 * Inst Nat Resour, Dep Earth Sci, Montana State Univ and Can Plains Res Cent, Univ Regina * 1983.

International treaties and orders, monitoring boards and provincial legislation have set the rules for management of water in international river basins. The lack of direct input by the province to the determination of natural flows, differences in balance periods in interprovincial and international streams, and strict adherence to a principle without regard for equitable sharing of the water resources, have created difficulties in the management of river systems and the allocation and use of water in the Saskatchewan portion of international basins. More direct involvement by the province in international water management and adoption of the concept of equitable use of the meagre water resources of these international basins would help to resolve the problems.

4.15 Evaporation - Evaporation

063690
HOPKINSON RF * **Temperature and evaporation on Lake Diefenbaker, 1981 and 1982** * Rep No CSS-R83-01 * 20p * Atmos Environ Serv, Environ Can * 1983-02.

The 1981 gross evaporation on Lake Diefenbaker in terms of depth was 928 mm and of volume, 381,000 cu dam, ranking 1981 second highest in both aspects over the 11 years of this project. An unusually early ice break-up in April and much higher than normal evaporation in September were the main reasons for the high evaporation in 1981. In contrast, the calculated gross evaporation in 1982 of 730 mm depth or 292,000 cu dam volume, was the least of any year from 1972 to 1982. The open water season in 1982 was the shortest of all years of this project and was associated with a late cool spring, a cooler than normal summer and a cold November.

063689
HOPKINSON RF * **Evaporation from Tobin Lake, 1982** * Rep No CSS-R83-02 * 10p * Atmos Environ Serv, Environ Can * 1983-04.

The gross evaporation from Tobin Lake in 1982 was 530 mm, the least of any year from 1974 to 1982. The evaporation was calculated using the Meyer mass transfer equation and on-site water temperature and meteorological data. Colder than normal water temperatures and lighter winds in most months were associated with the low calculated evaporation. The lack of evaporation in May accounted for nearly half of the negative anomaly over the open water season.

064002
QUINN FH, DEN HARTOG G * **Evaporation synthesis** . IN: IFYGL - The International Field Year for the Great Lakes * AUBERT EJ, RICHARDS TL * 221-245 * Natl Oceanic Atmos Adm, Great Lakes Environ Res Lab, US Dep Commer, Ann Arbor, MI 48104 US * 1981-03.

One of the primary objectives of the International Field Year for the Great Lakes was to study and compare methods for determining the evaporation from a large dimictic lake. To summarize and evaluate the various techniques and results, to recommend techniques for future evaporation estimates, and to improve the aerodynamic technique for application to Lake Ontario and the other Great Lakes. Evaluated in this study are the terrestrial water balance, the energy balance, the atmospheric water balance, and the aerodynamic evaporation techniques. Study of the pan evaporation technique was included in the original program but was not fully assessed. The data required for the analyses were provided primarily by the Terrestrial Water Balance, Lake Meteorology, Energy Balance, and Boundary Layer Panels. Both

weekly and monthly estimates were computed by the terrestrial water balance and the energy balance techniques; daily, weekly, and monthly estimates were derived by the aerodynamic method, based on buoy data limited to the period from April to December 1972. Daily estimates were computed by the atmospheric water balance technique for three intensive observation periods in the fall.

064006
RASMUSSON EM, SULLIVAN J, FERGUSON HL * **Atmospheric water balance** . IN: IFYGL - The International Field Year for the Great Lakes * AUBERT EJ, RICHARDS TL * 79-107 * Natl Oceanic Atmos Adm, Great Lakes Environ Res Lab, US Dep Commer, Ann Arbor, MI 48104 US * 1981-03.

This report analyses and summarizes the results of the Atmospheric Water Balance Program, one of the four major programs during the International Field Year for the Great Lakes designed to produce a best estimate of evaporation over Lake Ontario during the Field Year. Data from six rawinsonde stations established along the perimeter of Lake Ontario are used for direct evaluation of the atmospreric vapor flux divergence and the computation of the area-averaged difference between evaporation and precipitation as a residual from the balance or budget equation. Estimates of lake-averaged precipitation, obtained from radar observations and conventional precipation measurements in the adjacent land areas, are then used in conjunction with this quantity to obtain an estimate of lake-averaged evaporation. Characteristics of the data sets used for the computations are reviewed. The atmospheric water balance equation used in the study, as well as an examination of the assumptions involved in the use of rawinsonde data from discrete points along the lake's perimeter to evaluate the individual terms of the balance equation are discussed. A combination of noisy and missing data leading to the use of asymptotic singular decomposition in the analysis of the data, is included. This technique is reviewed as well as the problems and procedures of the data analysis.

4.16 Water Quality - Qualite de l'eau

4.16.1 Studies, Research, Analytical Methods, Assessment - Etudes, recherche, methodes d'analyse, evaluation

064627
The assimilative capacity of the Athabasca River for organic compounds * Alta Oil Sands Environ Res Program Res Rep * 106p * Alta Environ, 15th Floor, Oxbridge Place, 9820-106 St, Edmonton, Alta T5K 2J6 * 1980-08.

Background information relevant to an understanding of the assimilative capacity of the Athabasca River is presented. This includes information on the hydrogeology, surface water hydrology, biology of the river, algae, bacteria, benthic invertebrates, and on fisheries biology. The organic chemistry of the Athabasca River is described and the assimilation problem is addressed. Sources of organic compounds are described and an outline is presented of a proposed research plan including laboratory and field work. Recommendations are presented and as an appendix a report is given of a workshop held at Kananaskis in February of 1980 to discuss the issues raised by this report.

066129
Sediment/freshwater interaction, Proceedings of the Second International Symposium held in Kingston, Ontario, 15-18 June 1981 (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

063688
A water quality assessment of Kenogamisis Lake, District of Thunder Bay * 13p * Minic Priv Abatement Sect, Northwest Reg, Ont Minist Environ * 1982-07.

The Ontario Ministry of the Environment conducted a water quality survey of Kenogamisis Lake, District of Thunder Bay, during the first six months of 1981. This followed a preliminary investigation of potential arsenic and cyanide contamination, conducted during the summers of 1979 and 1980. Samples of lake water and domestic drinking water supplies were collected and analysed to determine if there was any water quality impairment as a result of previous mining activity and the resultant deposition of tailings in and adjacent to the lake. Iron and manganese levels were found to exceed Ministry drinking water objectives (0.3 and 0.05 mg/L respectively), in the waters adjacent to the tailings deposits. Those waters found to contain elevated metal levels are not being utilized as drinking water supplies. Sampled drinking waters, taken from the lake, all contained traces of arsenic; however, none exceeded the Ministry's drinking water rejection criterion of 0.05 mg/L As. Data collected over the past three years suggest that the arsenic concentration in Kenogamisis Lake has decreased. This, however, may not be the result of a long-term stable reduction, but rather due to overall climatic and hydrogeologic factors. Cyanide was not detected in the waters of Kenogamisis Lake.

063406
Interprovincial river quality data at PPWB monitoring stations, April 1974 to December 31, 1981 * 495p * Prairie Provinces Water Board * 1982-10.

The Prairie Provinces Water Board has established 11 common water quality-quantity

monitoring stations located near the Alberta-Saskatchewan and Manitoba-Saskatchewan boundaries to carry out its responsibilities as defined in the Prairie Provinces Water Board Master Agreement on Apportionment. The Board has also agreed that the 1973 Prairie Provinces Water Board Objectives, which were developed jointly by the Provinces of Alberta, Saskatchewan, and Manitoba, will be applied to interprovincial streams under the jurisdiction of the Board; and has set up a standing Committee on Water Quality to oversee, review, and report on water quality matters of interest to the Board. Regular monthly water quality monitoring has been conducted at these stations by the Water Quality Branch of Environment Canada since April 1, 1974 to establish an inventory of existing water quality at interprovincial boundaries and to establish compliance with the objectives. This report, the seventh annual publication of water quality data collected under the auspices of the Board, summarizes all water quality data collected by Environment Canada at the 11 PPWB stations from April 1, 1974 to December 31, 1981. All station locations and analytical methodologies are documented using the National Water Quality Data Bank (NAQUADAT) system. Statistical and graphical summaries of this data are presented by station in alphabetical order. To avoid further delays in the production of this report the Secretariat arbitrarily decided not to include in the graphical summaries, new parameter site codes which were assigned in the last quarter of 1981. However a detailed NAQUADAT retrieval of all data is included in the microfiche attached to the front cover. This mocrofiche can be used to make copies of this data in most libraries.

062577
AHMAD I * **On-line trace enrichment of difenzoquat in water and its determination by HPLC** * J Environ Sci Health Part B * B18(2) 207-218 * 1983-04.

A high performance liquid chromatographic (HPLC) method involving an integrated enrichment step is described for the quantitative determination of low levels of difenzoquat residues in water. Difenzoquat is trapped from the flowing water sample by strong adsorption onto the enrichment column. It is then desorbed, separated, and subsequently analyzed in a single step process by reverse phase high performance liquid chromatography using ultraviolet detection at 255 nm. Average recovery of difenzoquat from organic free water at spiking levels of 20, 10 and 5 ppb was 97.0%. The lower detection limit reached was 0.25 ppb difenzoquat in organic free water.

065837
AKENA AM, CHRISTIAN LL * **Water quality of the Athabasca oil sands area, Volume IV, an interim compilation of non-AOSERP water quality data** * AOSERP Rep L74 * 242p * Alberta Environ, Res Manage Div * 1981-10.

This report assembles non-AOSERP surface water quality data dating back to the 1950s. Because of a wide variety of sample collection, storage and analysis procedures, the report does not attempt to validate or evaluate the data bases in terms of AOSERP's general objectives. However, it can be used to supplement the AOSERP data base. All the data generated by the AOSERP regional water quality monitoring program and the Muskeg River watershed study are stored in Alberta Energy's NAQUADAT files.

063627
ALLAN RJ, MUDROCH A, SUDAR A * **An introduction to the Niagara River/Lake Ontario pollution problem** * J Great Lakes Res * 9(2) 111-117 * 1983.

Considerable public concern about contamination of Lake Ontario has been generated by suspected leakage of toxic chemicals from a multitude of hazardous waste dumps and by the several major chemical outfalls along the United States research side of the upstream Niagara River. A cooperative effort by Canadian and United States research scientists has begun to provide the basic information which may be required to enforce controls of loadings of toxic chemicals to this river/lake system. A holistic ecosystem approach, involving analyses of many contaminants in a variety of aquatic media, is necessary to properly manage the problem and assist in setting priorities.

064097
ALTA ENVIRON CENT * **Pesticides and PCBs in the North Saskatchewan River and Red Deer River** * AECV83-R4 * 24p * Alta Environ Cent, Vegreville, Alta T0B 4L0 * 1983-07.

This study describes the concentrations of pesticides and PCBs in fish collected between 1980 and 1982 from the North Saskatchewan River and the Red Deer River. Approximately 500 fish, mainly pike, walleye, sauger, goldeye and suckers, were collected. Determinations were made on both muscle and intestinal fat samples for a total of 45 compounds, including most pesticides commonly used in Alberta. In addition PCB concentrations in sediments from the North Saskatchewan River were also measured. Based on these collections, it is concluded that the concentrations of all compounds in fish were generally low and presented no immediate threat to human consumers. PCB residues in muscle tissue of fish from the North Saskatchewan River ranged from less than 0.01 to 1.66 mg/kg depending on species, compared to less than 0.5-104.0 mg/kg for intestinal fat samples. Residues in fish collected from the Edmonton area were not significantly higher than those found in other parts of the

river. PCB concentrations in sediments were generally below 0.01 mg/kg from Edmonton to the Saskatchewan border. Maximum PCB levels in the muscle tissue of fish from the Red Deer River ranged from less than 0.01 to 0.72 mg/kg, depending on species, compared to less than 0.01-15.9 mg/kg for intestinal fat samples. Methoxychlor was frequently found in goldeye from the North Saskatchewan River but was not recorded in any Red Deer River sample. Its presence in goldeye, a highly migratory species, was probably a result of biting fly control programs in the Saskatchewan portion of the river. Since PCBs, their metabolites and methoxychlor are known mutagens and potential carcinogens, the long term fate and partitioning of these compounds should be determined.

063280
AMBLER DC * **Surface water hydrology, Kejimkujik calibrated catchment program on the aquatic and terrestrial effects of the long-range transport of air pollutants** * IWD-AR-WRB-83-43 * 39p * Environ Can, Inland Waters Dir, Atl Reg, Water Resour Branch, 5th Floor, Queen Square, 45 Alderney Dr, Dartmouth, NS B2Y 2N6 * 1983-04.

An understanding of the physical processes of the surface water component in the hydrologic cycle supports the ability to both understand and forecast the movement of atmospheric pollutants once they have entered the surface water phase. The Kejimkujik Calibrated Lake Catchment Program is one of five national study areas to support research into the Long Range Transport of Atmospheric Pollutants. The study area and Kejimkujik National Park are within the Mersey River watershed in West Central Nova Scotia. This report summarizes the history of surface water data collection by the Water Survey of Canada Division of the Water Resources Branch, Environment Canada. The collected data are interpreted to define annual and monthly extremes, means and their variability. A water balance is calculated using actual precipitation data and calculated potential evapotranspiration. A monthly flow estimate is made for one of the study sites within the Park area.

067114
ANDREYCHUK AP * **Coliform bacteria content of some Alberta recreational waters** * 21p * Stanley Assoc Eng Ltd * 1980-03.

A report is presented of a study that reviewed and summarized available fecal and total coliform density data, to represent the bacteriological quality of recreational water in Alberta. The total and fecal coliform data are summarized according to minimum mean and maximum values for selected locations and are shown in tables. To indicate the regional variation of bacterial levels, the data are grouped according to the major drainage basins in Alberta. For each of the drainages, tables are structured to represent data commencing with the upper reaches following progressively to lowest reach. The data are also illustrated on a map exhibiting bacteriological densities within each of the drainages. The data and their respective monitoring sites aid in showing bacterial density variations as they relate to anthropegenic activities along the course of the streams. The bacteriological suitability of the waters are shown according to recreational water and potable water standards.

064530
ARCHIBALD PL, BURNS BE * **A baseline survey of the water quality and biological conditions in the streams of the Howard's Pass area, Yukon Territory** * Manuscr Rep 81-13 * 63p * Environ Prot Serv, Pac Reg, Yukon Branch, Environ Can * 1981-01.

A pre-development survey of water quality and biological conditions in the streams of the Howard's Pass area was conducted in July 1980. Generally, the water chemistry parameters measured showed no anomalies. The benthic macroinvertebrates and fish sampling results were respresentative of generally clear, unpolluted mountain streams. The high zinc concentrations in the stream sediments sampled reflected the presence of zinc ore deposits in the area.

064309
ASHLEY KI * **Hypolimnetic aeration of a naturally eutrophic lake: physical and chemical effects** * Can J Fish Aquat Sci * 40(9) 1343-1359 * 1983-09.

To examine the effect of hypolimnetic aeration on key components (circulation, decomposition, major nutrients, major ions, and pH interactions) of a lake ecosystem, I used a small naturally eutrophic lake. I divided the lake in half with a plastic curtain, and installed and operated a hypolimnetic aerator in the experimental half for a year. Hypolimnetic aeration had no effect on thermal stratification during the ice-free season but circulated the entire experimental half under ice cover. Aeration increased hypolimnetic turbidity via reduced detrital sedimentation but did not affect epilimnetic transparency. Hypolimnetic oxygen concentrations were increased as was oxygen consumption as both sediment and water column oxidation of organic material was enhanced. Hypolimnetic ammonia concentrations were reduced and sufficient oxygen was added for nitrification to occur. Internal phosphorous loading and hypolimnetic orthophosphate concentrations were reduced but aerobic P regeneration increased. Aeration vented accumulated CO2 from the hypolimnion and decreased its calcium, magnesium, bicarbonate, and orthophosphate content via calcium

carbonate phosphate coprecipitation. Management applications of hypolimnetic aeration include reduction of internal nutrient loading for eutrophication control, improvement of water quality for domestic use, and prevention of fish winterkill.

F10221
ASSOC QUEBECOISE DES TECH DE L'EAU * **L'usine d'epuration de la CRO: une realisation chiffree a 168 millions de $** * Rev munic * 61(4) 9-11 * Publ Vero Ltee * 1983-04.

Les recommandations d'un rapport sur le controle de la qualite de l'eau de la riviere Outaouais presente en 1971, se concretisaient par la signature d'une entente entre la Communaute regionale de l'Outaouais, le gouvernement du Quebec et la Commission de la Capitale nationale fixant les modalites de realisation d'un ouvrage de genie destine a assurer la collecte et l'epuration des eaux usees de l'agglomeration urbaine d'Aylmer, Hull et Gatineau.

065711
AUSTIN A * **Evaluation of changes in a large oligotrophic wilderness park lake exposed to mine tailings effluent for 14 years: the periphyton** * Naturaliste Can * 110(2) 119-134 * 1983-04.

Patterns of change occurred in periphytic communities on artificial substrates, exposed in a large oligotrophic wilderness park lake, sampled prior to and after 14 years of mine tailings effluent. Concentrations of the heavy metals Cd, Cu and Zn increased substantially whilst nutrients did not change over the study period. Organisms known to be sensitive to heavy metals, including several diatom species, either disappeared or became extremely rare. Other more tolerant forms, such as Navicula cryptocephala, have substantially increased in abundance. Accompanying these changes are decreased species number and diversity, and near the tailings effluent, a drop in cell density.

065338
BAARSCHERS WH * **Study of the biodegradation of man-made environmental toxicants by aquatic fungi, bacteria and fresh-water algae, progress report 1982** * 15p * 1983-01.

Objectives set for the past year could not all be realized, because of reduction in funding and personnel. Major attention was focussed on various aspects of the environmental fate of methoxychlor, and progress was made concerning fungal metabolism, interaction with algae, and outstanding synthetic questions. Quantitative assessment of fungal and algal metabolism, and an absorption study, are required to finalize work on this pesticide. Work on fenitrothion has been temporarily suspended due to lack of resources. Progress was made towards the preparation of 6-hydroxy picloram. Synthetic work on PAO-30E is about to be published, and financial support from industry will be sought after in order to continue biodegradation studies on these dielectric fluids.

062918
BAARSCHERS WH, ELVISH J, RYAN SP * **Adsorption of fenitrothion and 3-methyl-4-nitrophenol on soils and sediment** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

065853
BACCHUS A * **Dispersion of the Stratford sewage treatment plant effluent into the Avon River** * Stratford/Avon River Environ Manage Proj Tech Rep S-8 * 23p * Ont Minist Environ, 985 Adelaide St S, London, Ont N6E 1V3 * 1982-08.

As part of the Stratford-Avon River Environmental Management Project, the Water Resources Branch of the Ontario Ministry of the Environment investigated the possibility of creating a shore-attached effluent plume and mixing zone boundaries in the Avon River below the Stratford Water Pollution Control Plant (WPCP). In a survey conducted on June 18, 1980, Rhodamine-WT dye analyzed with standard fluorometric techniques was used as a tracer to determine the extent of the WPCP mixing zone. Data from the survey were used to calibrate the mixing zone model MIXAPPLN; MIXAPPLN was then used to make predictions of allowable total residual chlorine (TRC) and ammonia concentrations in WPCP effluent under various effluent and streamflow conditions. Survey results indicate that at 247 m downstream of the WPCP outfall, the effluent has completely crossed the stream. These observations suggest that it may be necessary to realign the outfall position and perhaps channelize the river bed downstream of the outfall in order to create a shore-attached effluent plume and a zone of passage for aquatic fauna. Results of subsequent computer modelling indicate that allowable effluent concentrations depend on the size of the limited use zone.

065856
BACCHUS A * **Experimental efforts to aerate the Avon River with small instream dams** * Stratford/Avon River Environ Manage Proj Tech Rep S-5 * 31p * Ont Minist Environ, 985 Adelaide St S, London, Ont N6E 1V3 * 1982-08.

As part of the Stratford-Avon River Environmental Management Project, the Water Resources Branch of the Ontario Ministry of the Environment carried out investigations on August 26-27, 1980 on the Avon River at a weir and a small rock dam at two separate locations to quantify the increase in dissolved oxygen (DO) due to aeration at the base of these dams. Further studies were carried out during the summer of 1981, in the Project's

experimental reach, to test for aeration efficiency using four weir designs with a maximum height of 0.5 m. Data from these surveys were then used as input for the DOMOD3 DO-BOD model to predict how far downstream the effects of the dam and weirs would persist. Survey results indicate that aeration is a function of height and turbulence. Since height is a limiting factor in the Avon River, because of the flat river banks, the 5-step design with a height of 0.5 m seems to be the best aerator for the Avon River. The modeling results indicate that the effects due to weir aeration persist from 43 m to 1281 m before DO drops below the Provincial Water Quality Objective of 47% saturation (approximately 4mg/L minimum) and from 470 to 1537 m before returning to background levels.

065857
BACCHUS A, WILLSON K * **Experimental efforts to inject pure oxygen into the Avon River** * Stratford/Avon River Environ Manage Proj Tech Rep S-4 * 31p * Ont Minist Environ, 985 Adelaide St S, London, Ont N6E 1V3 * 1983-06.

As part of the Stratford-Avon River Environmental Management Project, the Southwestern Region of the Ontario Ministry of the Environment carried out a preliminary experiment in July 1980 on the Avon River to investigate the viability of supplementing depressed night-time instream dissolved oxygen (DO) by injecting pure oxygen in the stream. Initial results were encouraging and a second experiment was carried out in July, 1981, by the Water Resources Branch of the Ontario Ministry of the Environment on the same river. The purpose of this investigation was to determine the effectiveness of oxygenation and the total number of installations that would be required to achieve compliance with the Provincial Water Quality Objective for DO for the lower Avon River. Data from this experiment were used to verify the one-dimensional stream DO model, DOMOD3, which was then used to simulate the effects of oxygenation under different conditions. Experimental results indicate that the beneficial impacts of oxygenation from 800 m to 1400 m downstream of the injection point; beneficial impacts are highly reach specific and depend on the physical, chemical, and biologic characteristics of the river. Modelling results indicate that at least 18 permanent installations would be required for a full-scale application of this technique to the lower Avon River. The capital cost of one installation is estimated at $18,900 (1982 dollars) and operating and maintenance costs at $1419 per month for five months per year. The oxygen injection technique can therefore be used to supplement reduced instream DO levels although it may not be economically feasible in all cases. For the Avon River, the latter seems to be the case.

064522
BAILEY HS * **International Saint John River fecal coliform survey, August 1982** * IWD AR-WQB-83-38 * 18p * Water Qual Branch, Inland Waters Dir, Environ Can, Moncton, NB * 1982-12.

A bacteriological survey for fecal coliform was conducted on the Saint John River between the St. Francis River and Grand Fall, N.B. in August 1982. The purpose of this survey was to measure compliance of the ambient water with water quality objectives for fecal coliform. The use-specific water quality objectives develped by the International Technical Advisory Subcommittee for the International Water of the Saint John River Basin require that the fecal coliform limit to protect swimmers should not exceed the log mean of 200/100 mL and no single sample should exceed 1000/100 mL, based on a miniumum of not less than five samples taken over a thirty-day period. The Water Quality Branch of Inland Waters Directorate monitors water quality for selected physical and chemical parameters every six weeks at eleven sites in the Saint John River Basin. For this study, seven of these sites were sampled six times over a two-week period in August 1982. This report discusses the data obtained from the bacteriological survey and identifies areas of non-compliance with the fecal coliform water quality.

065092
BAILEY HS, HOWELL GD * **Survey of toxic organic constituents in the Atlantic Region's aquatic environment (1979/81)** * IWD-AR-WQB-83-48 * 60p * Environ Can, Inland Waters Dir, Water Qual Branch, Atl Reg, Moncton, NB * 1983-10.

In order to identify and quantify some of the toxic organic chemicals in the aquatic environment, eighty-four sites in the Atlantic Provinces were sampled over a three-year period (1979-81) and screened for one or more of the following: carbofuran, chlorobenzenes, mirex, pentachlorophenol, phthalic acid esters, polynuclear aromatic hydrocarbons, polychlorinated biphenyls and/or triaryl phosphates. This survey resulted in the identification of a number of areas with measurable concentrations of organic chemicals suggesting anthropogenic influences.

065326
BALCOM RL * **Water quality survey Clements Pond, Shelburne County, Nova Scotia** * 11p * 1980-01-21.

The survey was carried out to determine lake water quality. Deterioration of the lake water quality was first noticed after a fish reduction plant was located near the shore. The plant had been dumping fish waste into the lake since about 1955 until September 1979. Clements Pond is a shallow lake located in Shelburne County, near Highway No. 3. The lake has a surface area of approximately 380

hectares, and a maximum depth of about 3.0 meters. A new fish reduction plant was established at Clements Pond in 1979 on the understanding that the effluent discharged into the lake would not affect the aquatic environment. Company president, Mr. R. Malone assured the Department of the Environment that adequate precautions would be taken to protect the lake. A 12-month operating permit for the new plant was issued to Fish Reduction Ltd. in April 1979. A four-man team surveyed the lake in December, 1979. A grid pattern was used to establish sampling locations. Water samples were taken at the surface and bottom of the lake. Dissolved oxygen and temperature profiles were taken at the same locations. Water samples were transported to the Halifax Public Health Lab for analysis.

065307
BALCOM RL * **Water quality survey 2, Clements Pond, Shelburne County, Nova Scotia** * 12p * 1980-06-16.

This survey was carried out on April 30, 1980 as a follow-up to the survey completed in December 1979. The purpose of the survey was to determine if the lake water quality would change with the seasons of the year and also to determine what effect the plant effluent would have on the receiving water quality. Clements Pond is a shallow lake with a surface area of approximately 380 hectares, and it is located in Shelburne County, near Highway Number 3. A new fish reduction plant was established at Clements Pond in 1979 to replace an aging plant that was polluting the lake. The new facility has greatly reduced the quantity of organic contaminants entering the receiving waters; however, the plant effluent is toxic to fish species. A twelve month operating permit for the new plant was issued to Fish Reduction Limited in April 1979. A three man team surveyed the lake in April 1980, following the same grid pattern that was used in the December 1979 survey. Water samples were taken at the surface and at the lake bottom, these samples were transported to the Halifax Public Health Lab for analyses.

064419
BANGAY GE * **Great Lakes development and related water quality problems** . IN: International Association of Theoretical and Applied Limnology, Proceedings, JP * SLAKECEK V * 21(3) 1640-1649 * E Schweiz Verlagsbuchhandlung, D-7000 Stuttgart 1, DE * 1981.

The history of Great Lakes development from 1678 - present, including the 1909 Boundary Waters Treaty and the establishment of the International Joint Commission to perform judicial, investigative, administrative and arbitrational functions, is described, focusing on changes in water quality which were manifestations of the rapid changes taking place in the watershed. The evolution of the Great Lakes megalopolis due to increasing urbanization, the resulting excessive pollution, and the identification of water quality problems associated with industrial wastes, are examined. The sources and effects of wastes from the forest industry, mining, iron and steel, agriculture, and urban areas, are described. The complexity of the linkages which exist between the basin's social and economic development and Great Lakes water quality is emphasized with a perceived need for a new dialogue between those studying the lakes, those charged with their management and those ultimately utilizing the resources.

062333
BARICA J * **Lake Erie oxygen depletion controversy** * J Great Lakes Res * 8(4) 719-722 * 1982.

A summary of a special workshop held at the Canada Centre for Inland Waters, Burlington, Ontario, 2-3 December 1981, is presented. The purpose of the workshop was to air some differences of opinion regarding the response of the hypolimnetic anoxia of Lake Erie to phosphorus controls. The workshop confirmed the validity of the 1978 U.S.-Canadian Great Lakes Water Quality Agreement's goals on restoring year-round aerobic conditions in the hypolimnion of the central basin of Lake Erie through phosphorus loading reduction. The author served as workshop chairman and convenor.

064328
BARICA J, GIBSON J, HOWARD W * **Feasibility of snow clearing to improve dissolved oxygen conditions in a winterkill lake** * Can J Fish Aquat Sci * 40(9) 1526-1531 * 1983-09.

Although periodic mechanical snow removal from the surface of an experimental plot on Rock Lake, southern Manitoba, between January and February, did not provide an expected increase of dissolved oxygen levels that would reduce the likelihood of fish winterkill in the localized area of the lake, it provided a basis for analyzing the practicality and feasibility of the method. The minimum lake area to be kept clear of snow for prevention of winterkill was calculated to be 15% of the total lake area. Snow clearing should start soon after freeze-up to provide at leat 03. g per sq m per d dissolved oxygen needed to compensate for bacterial oxygen uptake during the winter months.

065596
BARNWELL TO, JAMES W (ED) * **Proceedings Stormwater Management Model (SWMM) Users group meeting, January 19-20, 1981** (see chapter 4.3 for complete reference - voir chapitre 4.3 pour la reference complete)

062394
BEGHELLI S, GUIDORZI R, TERRAGNI F, HALFON E * **Identification of phosphorus dynamics in Kootenay Lake, Canada** * Ecol Modelling * v17 11-32 * 1982.

This paper regards the use of system theory techniques in the development of models describing the phosphorus kinetics in fresh waters with the objective to understand the observed kinetics better in order to obtain indications on the design of future field experiments. Identification techniques have been applied to the data regarding 49 experiments on phosphorus cycling in Kootenay Lake, British Columbia, Canada, in order to determine the minimal number of compartments required to model the phosphorus dynamical behaviour. Canonical state-space models have then been identified both from raw and smoothed data. The parameters in these models do not have a direct physical meaning; they can, however, be identified from the measured data and the obtained models described with good accuracy the considered kinetics. The identification of physical models has also been performed; in this case, however, only two compartments have been considered according to the results of the identifiability analysis of the complete model parameters. Results give further insight on the phosphorus processes and show that the complete phosphorus cycle through the four compartments described by Lean can be identified only when phosphorus cycles rapidly through the system.

062232
BELL CR, HOLDER-FRANKLIN MA, FRANKLIN M * **Correlations between predominant heterotrophic bacteria and physicochemical water quality parameters in two Canadian rivers** * Appl Environ Microbiol * 43(2) 269-283 * 1982-02.

The heterotrophic bacterial populations in two contrasting rivers have been examined over a period of 1 year. The populations were analyzed (i) as total heterotrophic counts, (ii) as species numbers, using numerical taxonomy, (iii) by diversity indices, and (iv) by factor analysis. Isolates were obtained by plating directly from water samples and by chemostat enrichment. Four factors emerged which profiled the bacterial community and were common to both rivers. They were, in order of decreasing importance, fermentative metabolism, inorganic nitrogen metabolism, fluorescence-oxidative metabolism, and lack of starch hydrolysis. Several factors produced significant correlations with a range of physiochemical parameters, which were also measured. The correlations suggested an intricate algal-bacterial interaction. The oxidative metabolism factor correlated with rainfall in one river, suggesting that the oxidative bacteria may be washed in from the surrounding land. In the other river, the oxidative-fermentative factor correlated negatively with sunshine. Factor analysis was the most effective method for revealing correlations between bacterial characteristics and the environmental parameters; however, the use of a variety of methods provided more insight into the ecological aspects.

063900
BELLIVEAU PE, BAILEY HS * **Survey of toxic inorganic constituents in the Atlantic region's aquatic environment (1979-81)** * IWD-AR-WQB-83-40 * 41p * Water Qual Branch, Atl Reg, Inland Waters Dir, Environ Can, Moncton, NB * 1983-03-15.

In order to identify and quantify some of the toxic inorganic chemicals in the aquatic environment, seventy-eight sites in the Atlantic Provinces were sampled and screened for arsenic, cadmium, lead and/or mercury. This three year survey (1979-81), involving the analysis of both water and bottom sediments, resulted in the identification of a number of contaminated areas and areas requiring further scientific investigation.

063906
BENNETT EB * **The nitrifying of Lake Superior, 1880-2000** * Manuscr Rep Ser No 13 * 26p * Oceanogr Div, Ocean Sci Surv, Bayfield Lab Mar Sci Surv, Fish Oceans, PO Box 5050, Burlington, Ont L7R 4A6 * 1982-06.

In Lake Superior, the world's second largest freshwater lake, the concentration of nitrate has increased exponentially from 75 ppb N in 1906, to 310 ppb N in 1976. Information on total nitrogen and phosphorus in the water sediments of the lake is used to develop nitrogen budget models which indicate that the apparent loading of nitrogen has risen in the same manner, and by a factor of six in 100 years. Although two-thirds of the nitrogen input has been retained in the lake water, hence increasing the concentration, the nitrogen content now is only one-quarter of the equilibrium value corresponding to the present loading rate. If the loading rate continues to increase, so will the equilibrium value toward which the system is attempting to adjust. Most of the nitrogen input to Lake Superior originates outside of the lake drainage basin and is by way of atmospheric deposition directly onto the lake surface. The calculated trend in loading parallels that of emissions of anthropogenic nitrogen oxides in the industrial Midwest and Great Lakes areas of North America.

F11957
BERON P, BRIERE F, ROUSSELLE J, RILEY JP * **Etude du controle en temps reel d'un intercepteur unitaire** (see chapter 4.3 for complete reference - voir chapitre 4.3 pour la reference complete)

065702
BETHEL G, BURNS BE * **The chemical and bacteriological effects of municipal discharges on the Yukon River from the City of Whitehorse, 1977-1980** * Reg Program Rep No 81-28 * 98p * Environ Can, Environ Prot Serv * 1981-10.

The Yukon River passes through the town of Whitehorse, Yukon Territory, where it receives effluent from two sewage lagoon systems as well as storm sewers. This study is a chemical and bacteriological impact assessment of river water quality before and after construction of the largest lagoon system. Analyses were performed by the Environmental Protection Service (EPS) laboratories in West Vancouver, British Columbia, using standard methods. Bacteriological analyses were performed by EPS staff in Whitehorse using membrane filter techniques for total and faecal coliforms. Water chemistry results suggest an oligotrophic river system which shows an insignificant chemical impact from municipal effluents. Bacteriological results show characteristics found in other northern rivers receiving municipal effluents. Recreational use standards for faecal coliforms of 200 counts per 100 millilitres are exceeded by individual samples taken downstream of lagoon discharges, especially during river low flow conditions. The study shows that the lagoon systems have made no significant reduction in faecal coliform counts in the river as compared to the discharge of raw sewage.

063224
BIRMINGHAM B, THORNDYKE M, COLMAN B * **The dynamics and persistence of the herbicide Aquakleen (R) in small artificial ponds and its impact on non-target aquatic microflora and microfauna** , IN: Proc 8th Annu Aquatic Toxicity Workshop, 2-4 Nov 1981, Guelph, Ont * Can Tech Rep Fish Aquat Sci 1151 * 12-23 * 1983-03

Outdoor artificial ponds planted with Myriophyllum spicatum were treated with Aquakleen granules (20% butoxyethanol ester of 2,4-D: BEE) at the rate of 23 kg active ingredient per ha. M. spicatum completely collapsed 5 days after application, and filamentous green algae had invaded the ponds by 21 days. Significant decreases in dissolved O2 level and pH, and increases in dissolved inorganic carbon occurred 7 days after treatment. No dissolved nutrient increase was detected on decay of the weeds and unicellular algae did not bloom. Zooplankton numbers declined in the 14 days following treatment due to the reduction in number of rotifers and ostracods.

066404
BIRTWELL IK, GREER GL, NASSICHUK MD, ROGERS IH * **Studies on the impact of municipal sewage discharged onto an intertidal area within the Fraser River estuary, British Columbia** * Can Tech Rep Fish Aquat Sci 1170 * 64p * Dep Fish Oceans, West Vancouver Lab, West Vancouver, BC * 1983-05.

A major sewage treatment plant at Iona Island discharges up to 1.53 x 10 sup 6 cu m per d of combined stormwater, domestic and industrial waste onto the intertidal area of Sturgeon Bank in the estuary of the Fraser River. At low tide the effluent is conveyed across extensive sandflats within a dredged channel which extends more than 6 km into Georgia Strait. The preliminary studies presented here were carried out to assess the effects of the effluent on water quality, fish survival, distribution and aoundance. The survival of juvenile chinook salmon Oncorhynchus tshawytscha during in-situ bioassay experiments increased with distance from the sewage outfall, however, fish mortality occurred at all experimental sites within 4.4 km from the outfall. Mortality often was rapid and on one occasion all the test fish placed 2.2 km from the outfall died within 9 minutes. The low levels of dissolved oxygen which resulted from the discharge of sewage were probably a contributing factor in the mortality of the caged fish.

065342
BLACHFORD DP * **Spatial and temporal trends in the fluvial transport of metals and phosphorus in the Bow and Oldman Rivers, Alberta** * 242p * Dep Geogr, Queen's Univ, Kingston, Ont * 1982.

Conventional water quality monitoring programs depend upon 'total' and where possible 'filterable' contaminant concentrations in water. The present study identified the pathways of metals, phosphorus and organochlorine compounds in water, suspended sediments and plants. Pathway information is evaluated in terms of the ability of conventional water quality information to identify spatial and temporal trends and causality of contaminant stress in the aquatic environment. The study focusses upon the reach of river extending downstream from Calgary on the Bow River and from Lethbridge on the Oldman River to their confluence at Bow Island. Water and suspended sediment samples were collected by hydrologic synoptic sampling during the spring, early summer, summer and fall discharge regimes. Aquatic plants were collected during the summer and fall. Water samples were analyzed by conventional methods for 'total' and 'filterable' metals and phosphorus and were scanned for organochlorine residues. Sediments and plants were analyzed for 'total' metal and for phosphorus species. Conventional measures of 'total' and 'filterable' metals are not able to characterize spatial and temporal changes in concentration. Suspended sediments and plants reflect downstream changes in river chemistry. Plants are useful indicators of the bioavailable component of

metal flux. Conventional metal loadings are inaccurate due to large biomass-associated metal loads. Measures of TP and TDP adequately reflect phosphorus trends but do not account for the biomass-associated load. Sediment-phosphorus speciation is required for downstream management purposes in order to characterize the potentially available phosphorus forms. Nutrient abatement programs for the purpose of plant control must be cognizant of rapid luxury consumption, upstream seeding and hydraulic conditions.

063540
BODO B, UNNY TE * **Sampling strategies for mass-discharge estimation** * J Environ Eng * 109(4) 812-829 * 1983-08.

Methodology derived from sampling theory is presented for the estimation of in-stream contaminant mass-discharge or load. The historical record is stratified into relatively homogeneous units in order to approach normality in the subpopulations thereby reducing the inaccuracies introduced by the highly skewed populations. Within strata a ratio estimator is employed to estimate the load and variance of the subpopulations. Strata are also defined to minimize other forms of inaccuracy. Estimates for individual strata are combined to produce pooled estimates for the desired period of interest. With a prior data base, sampling theory is employed to devise sampling strategies designed to produce load estimates of a specified target precision in future studies. Case studies demonstrate the significance of flow events as the primary transport mechanism for suspended sediment and the need to sample such events intensively in order to achieve reliable load estimates. Small 'flashy' streams require sampling of much greater intensity during events than larger rivers with attenuated event response in order to produce load estimates of comparable precision.

063058
BONNER RF, MERESZ O * **St. Clair River organics study, Identification and quantitation of organic compounds** * 219p * Ont Minist Environ, Lab Serv Branch, Org Trace Contam Sect * 1981-02.

This report presents and discusses data on the organic compounds present in a variety of samples collected from the vicinity of the St. Clair River in 1977 and 1978. It forms part of a major study on this river system which was initiated following exploratory work in 1975/76. Background information to the St. Clair River system is provided including data on the river itself, on the industries (location, product types, and water usage) and on the sewage treatment plants. Also summarized are the total organic carbon values and flows measured at the time of the 1977 sampling and the results of calculations indicating the daily discharge of organic carbon to the river. The sites are considered by category headings in the direction of flow such as contributors to the organic loading and indicators of the water quality. The sampling program for the 1977 study is described and the analytical procedures employed are described. The analytical results are presented by category in the direction of river flow. A discussion section summarizes each site, highlights the significant organic compounds observed, including PCB concentrations and discusses the results in terms of hazards to the environment and human health. Conclusions and recommendations of the report are summarized and miscellaneous data is presented in the appendices. Appendix 1 contains total organic compounds, flow and organic loading data for the industrial effluents. Appendix 2 presents toxicological data on some of the major components and Appendix 3 describes some of the additional studies undertaken on the effects of chlorination on trace organics.

065870
BOTHWELL ML, DALEY RJ * **Selected observations on the persistence and transport of residues from Aqua-Kleen 20 (2,4-D) treatments in Wood and Kalamalka Lakes, B.C.** * 62p * Environ Can, Environ Conserv, Inland Waters Dir, Pac and Yukon Reg, Vancouver, BC * 1981-08.

Analytical methods for 2,4-dichlorophenoxyacetic acid (2,4-D), 2,4-D butoxyethanol ester (2,4-D BEE) and 2,4-dichlorophenol (2,4-DP) were evaluated and procedures developed for sediment analysis. The long-term persistence of these three herbicide residues was examined in the sediments of Wood and Kalamalka Lakes, B.C., treated with Aqua-Kleen 20 in 1979. In both lakes, 2,4-D was the longest lived of the three forms. The presence and transport of 2,4-D BEE and 2,4-D in the microlayer at the air-water interface were also examined, both in the field and in laboratory aquaria. Several processes influencing concentration and short-term persistence of 2,4-D BEE were examined in laboratory experiments. The theoretical half-lives of 2,4-D BEE under different temperature and pH conditions were empirically confirmed.

064091
BOURQUE S, HEBERT G * **A preliminary assessment of water quality and biota in the Serpentine and Nicomekl rivers and Mahood Creek** * Reg Prog Rep 82-17 * 70p * Dep Environ, Environ Prot Serv * 1982-12.

A program of regular sampling for 16 routine water quality parameters; bottom macrointervertebrate populations; periphyton populations, biomass and pigment content; and levels of various metals in fish flesh was undertaken on Mahood Creek and the Serpentine and Nicomekl Rivers from June 1974 until

November 1975. Salmonid populations in these streams could be harmed if intensive farming practices in the lowlands and increased urbanization in the uplands is not managed to protect water quality and maintain adequate water flows.

066615
BRADFORD RG, BINGHAM RA, MEISNER JD * **Water quality survey of the Saint John River below the proposed Dickey-Lincoln hydroelectric development, 1978-1980** * IWD-AR-WQB-82-35 * 20p * Environ Can, Water Qual Branch, Moncton, NB E1C 8N6 * (1981).

An American proposal for construction of two dams in the Dickey-Lincoln School portion of the Saint John River, five kilometers upstream from the Canadian border has caused a great deal of controversy both in Canada and in the United States concerning among other things, its impact on water quality in the downstream sections. This report details results of a survey of water quality and benthic phytoplankton and invertebrates, carried out by the Water Quality Branch between the St. Francis River and Clair, N.B. to determine the pre-impact (baseline) conditions of the river.

F10456
BROUARD D * **Inventaire limnobiotique sommaire du bassin de la riviere Caniapiscau en aval du lac Duplanter et perspectives d'amenagement** * 15p * Soc d'amenagement gen de l'environ, Quebec, Que * 1980-08.

Dans le cadre d'une etude qui vise a accroitre les connaissances sur la faune piscicole du bassin hydrographique de la riviere Caniapiscau, en aval de Duplanter, ce rapport d'etape est un compte rendu des operations et des resultats obtenus lors de l'echantillonnage extensif qui s'est deroule du 25 juin au 29 juillet 1980. Les objectifs poursuivis concernent l'ichtyofaune; ils visent a evaluer les repercussions de la derivation de la riviere Caniapiscau et a jeter les bases d'interventions mitigatrices possibles. En plus de fournir certaines donnees concernant la qualite de l'eau, l'echantillonnage a permis de recolter 813 specimens en milieu lacustre et fluvial, regroupant 12 especes. Le nombre des captures et la biomasse pour chacune des especes sont compiles pour chaque station. Suite a cet expose, la liste des stations qui seraient inventoriees lors de l'echantillonnage intensif debutant le 2 aout 1980 est presentee.

063204
BROWN EJ, LUONG HV, FORSHAUG JM * **The occurrence of Thiobacillus ferrooxidans and arsenic in subarctic streams affected by gold-mine drainage** * Arctic * 35(3) 417-421 * 1982-09.

Thirty-five streams in gold-mining regions between Rampart, Alaska, and Dawson City, Yukon Territory, were sampled to determine dissolved arsenic concentrations, and numbers of the acidophilic iron- and sulfur-oxidizing bacterium Thiobacillus ferrooxidans. The pH of the streams varied from 6.3 to 8.6 and the streams were nearly saturated with dissolved oxygen. T. ferrooxidans was found in eight of nine streams affected by gold-mine drainage and in only one of 26 streams not affected by gold-mine drainage. Some of the streams affected by gold-mine drainage near Fairbanks, Alaska, occasionally contained levels of dissolved arsenic above 50 parts per billion. The recognition that T. ferrooxidans is associated with gold-mine material and that the heavy metal arsenic exists in streams affected by gold-mine wastes is important for understanding the environmental effects of mining activity on subarctic streams.

061837
BROWN MH * **The forgotten Great Lake** * Audubon * 84(6) 88-95 * Natl Audubon Soc, 950 Third Ave, New York, NY 10022 US * 1982-11.

This article describes how Lake Ontario is struggling for its life at a time of nuclear and chemical proliferation, eroding shorelines, and simple governmental neglect. American communities along Lake Ontario, including a detailed look at Rochester, are examined. On the Canadian side, the city of Toronto is praised as the economic, cultural and intellectual capital of Canada. A history of the city and the change from a quiet town into a vibrant city, is described, including discussions on its many tourist attractions, valuable real estate and immigrants' contributions. This onshore excitement is contrasted with the endangered waters of Lake Ontario and the ecosystems that depend on it. Pollutants in the Lake, including Mirex and DDT, and their effects, are described, especially on fish and wildlife. Combined chemical and radioactive pollution, and the concerns of the provincial government for this problem, are reviewed. Efforts made to control the pollution problem in Canada are discussed and it is pointed out that help from the governments on both shores is needed to help the Lake along in its recovery.

065295
BROWNLEE BG, MURPHY TP * **Nitrogen fixation and phosphorus turnover in a hypertrophic prairie lake** * Can J Fish Aquat Sci * 40(11) 1853-1860 * 1983-11.

Nitrogen fixation by algae Aphanizomenon flos-aquae in a prairie lake in southwestern Manitoba was dependent on the light intensity and in situ oxygen concentrations. The mean molar ratio of acetylene reduction to nitrogen reduction was 5.8:1. High external ammonium concentrations did not appear to inhibit nitrogen fixation over the short term.

Nitrogen fixation was not directly initiated by the bloom collapse. We propose that the coupled sequence of ammonia volatilization and nitrogen fixation was triggered by the bloom collapse and that the bloom collapse was caused by coprecipitation of orthophosphate with carbonates. 32P04 turnover was most rapid during periods when the lake was opalescent, presumably due to carbonate precipitation.

065906
BUCKLEY DE, WINTERS GV • **Geochemical transport through the Miramichi Estuary** . IN: Conf on Pollution in the North Atlantic Ocean, Halifax, NS, Oct 19-23, 1981 • Can J Fish Aquat Sci • 40(suppl 2) 162-182 • 1983.

A 2-yr seasonal study of the physical oceanography, geochemistry, and sedimentology of the Miramichi Estuary, New Brunswick, demonstrated that the overall system consists of two compartments: a drowned river, variable salt wedge estuary which is normally highly stratified, and the connected Inner Bay which is slightly stratified to well mixed. Freshwater inputs at the head of the estuary vary from 50 to 250 cu m per s during summer and winter to high flows of 300 to 1700 cu m per s during spring. Suspended particulate matter (SPM) and several labile trace metals including Fe, Mn, Zn, Cu, Pb, and Cd were analyzed to determine the total transport of potential contaminants within the system and into the Gulf of St. Lawrence. Wide variations in concentrations of SPM and labile metal by more than an order of magnitude are a function of freshwater input rates, tidal prism flushing characteristics, and geochemical interactions within the estuary.

062388
BUKATA RP, BRUTON JE, JEROME JH, JAIN SC, ZWICK HH • **Optical water quality model of Lake Ontario. 2: Determination of chlorophyll a and suspended mineral concentrations of natural waters from submersible and low altitude optical sensors** • Appl Optics • 20(9) 1704-1714 • 1981-05-01.

Spectrooptical and water quality data collected from a 1979 coordinated in situ and airborne study of western Lake Ontario are used to devise a five-component model from which subsurface chlorophyll a and suspended solids concentrations may be determined from submersible optical sensors capable of measuring spectral irradiance reflectance just beneath the free-surface layer. A water-air interface model, which incorporates the effects of surface reflection, is also presented in an attempt to extend such water quality estimations to low altitude remote sensors. Special emphasis is given to the spectral wavelength bands of the Coastal Zone Color Scanner aboard Nimbus-7.

062236
BUKATA RP, JEROME JH, BRUTON JE • **Validation of a five-component optical model for estimating chlorophyll a and suspended mineral concentrations in Lake Ontario** • Appl Opt • 20(20) 3472-3474 • 1981-10-15.

The suspended and dissolved materials present in natural water masses strongly dominate the irradiance reflectance measurable just beneath the water-air interface of inland lakes. The authors have recently reported the development of a five-component optical model to estimate the chlorophyll a and suspended mineral concentrations of lake waters from measurements of the subsurface spectral irradiance reflectance. In this letter a five-component water quality model is assumed in which the Lake Ontario waters at any instant of time are taken to be defined by some homogenous combination of unique organics, unique inorganics, unique nonliving organics, and dissolved organic material in addition to pure water. The letter presents results of an independent validation of the five-component water quality model. Sampling stations in Lake Ontario were visited by ship surveys in 1979 and 1980. Data were obtained on upwelling and downwelling irradiance profiles, using a OSM 2500 scanning Quanta spectrometer in the upper 10 m of water, and on transmission profiles and water samples. Results of this independent validation experiment indicate that the model and the optical cross sections contained in it have a lake-wide applicability to water quality determinations. More significantly, the model applicability is neither atmospheric nor data-set dependent.

062389
BUKATA RP, JEROME JH, BRUTON JE, JAIN SC, ZWICK HH • **Optical water quality model of Lake Ontario. I: Determination of the optical cross sections of organic and inorganic particulates in Lake Ontario** • Appl Optics • 20(9) 1696-1703 • 1981-05-01.

A five-component optical model of Lake Ontario is discussed in terms of unique organics (as represented by chlorophyll a), unique inorganics (as represented by total suspended minerals), unique nonliving organics, and unique dissolved organics. Direct measurements of the irradiance attenuation coefficient K(0), the diffuse reflectance R(0), and the total attenuation coefficient c are used in conjunction with simulated solutions of the radiative transfer equations to determine the inherent optical properties of the water masses. Multiple regressions between these inherent optical properties and directly measured water quality data are then performed to determine the absorption, scattering, and backscattering cross sections of the organic and inorganic components.

F11442
BUR ETUDE SUR SUBST TOXIQUES * **La problematique des substances toxiques dans l'environnement, tome 10: resume de la problematique, deuxieme edition** * 63p * Bur etude sur subst toxiques, Minist environ du Que * 1980.

Ce document se veut une reflexion sur la problematique des substances toxiques dans l'environnement quebecois. Le texte a aussi pour but d'expliquer succintement la perception actuelle du probleme de la contamination par les substances toxiques, combine l'approche scientifique et le style journalistique pour presenter un portrait de la situation, en deux dimensions: 1) un etat de la contamination du milieu quebecois par les substances toxiques sur la foi des donnees existantes 2) une approche d'intervention pour contrer cette contamination compte tenu de sa gravite. Les cahiers thematiques suivants ont servi de base a la presente synthese: 1) l'agression toxique 2) elements d'une approche rationnelle des problemes environnementaux 3) methodologie d'analyse des situations d'agresseur par les substances toxiques 4) les substances toxiques presentes dans l'environnement 5) l'inventaire sommaire des activites dans le domaine des substances toxiques 6) la problematique generale de la presence de ces substances 7) les moyens d'intervention face a la presence des substances toxiques 8) les substances toxiques dans le fleuve Saint-Laurent 9) le Saint-Laurent maritime et les toxiques, elements de problematique.

062748
BURNISON BK, LEPPARD GG * **Isolation of colloidal fibrils from lake water by physical separation techniques** * Can J Fish Aquat Sci * 40(3) 373-381 * 1983-03.

A colloid fraction, highly enriched for organic fibrils, can be isolated routinely by physical means. The physical isolation scheme used here provides gram quantities of undenatured samples in a short time from the epilimnion of a small mesotrophic lake. The total scheme is described in detail and is accompanied by an assessment of yield and contamination at each individual step using a transmission electron microscope as a monitor. The potential importance of organic fibrils is emphasized by a 1980 summer measure showing a fibril fraction to contain three times more carbon than the conventional particulate organic carbon fraction (POC) and 33% of the total dissolved organic carbon (DOC).

065117
BYRTUS G * **Athabasca River monitoring program 1980** * 61p * Pollut Control Div, Alta Environ * 1981.

The use of methoxychlor in the Athabasca River to control black fly (Diptera: Simuliidae) larvae was monitored in 1980 by Alberta Environment. Effective control of black fly larvae was observed for a distance of 60 km. The effect of the methoxychlor on non-target invertebrate organisms was considerable at sites located 60 km and closer to the treatment points, however, complete recovery was observed over the summer. Methoxychlor residues in the silt bedload dissipated fairly rapidly after treatment. Adult black fly activity data indicated that adults were more abundant in August than in June, suggesting that methoxychlor treatment of the river in late May had an effect on reducing adult numbers in the farming area during June.

065116
BYRTUS G * **Athabasca River monitoring program - 1981** * 63p * Pollut Control Div, Alta Environ * 1982.

The Pesticide Chemicals Branch of Alberta Environment conducted a monitoring program in 1981 related to two methoxychlor treatments of the Athabasca River for black fly (Diptera: Simulium arcticum) control. Three populations of black fly larvae were observed in 1981 and the first two populations were reduced by 95.4% (May 20/21 treatment) and 96.5% (June 19 treatment) respectively. Population reductions of non-target organisms due to methoxychlor was limited for the May 20/21 treatment but was considerable for the June 19 treatment. Water samples collected from the Athabasca River at Fort McMurray contained only trace amounts of methoxychlor. Adult black fly activity in the farming area peaked in late July, correlating with expected adult emergence.

065118
BYRTUS G * **Athabasca River monitoring program - 1979** * 69p * Pollut Control Div, Alta Environ * 1981.

The Pesticide Chemicals Branch of Alberta Environment conducted a monitoring program in 1979 related to two methoxychlor treatments of the Athabasca River for black fly (Simulium arcticum) control. Three populations of black fly larvae were observed in 1979 and the first two populations were reduced by 91.5% (June 7 treatment) and 98.1% (July 11 treatment) respectively. Population reductions of nontarget invertebrate organisms was observed but recovery was fairly complete within 4 weeks of treatments. Silt samples collected over the summer indicated that methoxychlor did not accumulate in the river bottom silt. Water samples that were collected for the July 11 treatment at Fort McMurray (250 km downstream of treatment point) indicated that maximum concentrations of methoxychlor present in the river water was 3.5 ppb. Adult activity sampling indicated that there was a fairly close relationship between adult emergence expected through larval development data and adult activity measured along the

river.

F11396
CAILLE A * **La problematique des substances toxiques dans l'environnement, tome 8: Les substances toxiques dans le fleuve Saint-Laurent, deuxieme edition** * 30p * Bur etude sur subst toxiques, Minist environ du Que * 1980.

La problematique des substances toxiques dans le fleuve Saint-Laurent s'inscrit dans le cadre plus large de la problematique des deteriorations de l'environnement. Ce rapport regroupe l'ensemble des elements de l'analyse effectuee dans le cadre du programme sur le fleuve en rapport avec la dissemination des toxiques. La premiere etape de cette analyse comprend la definition et la classification des substances toxiques; la seconde traite de l'identification des principales causes; la troisieme partie concerne la definition des problemes environnementaux.

062354
CAMPBELL JA, YEATS PA * **The distribution of manganese, iron, nickel, copper and cadmium in the waters of Baffin Bay and the Canadian Arctic archipelago** * Oceanol Acta * 5(2) 161-168 * Gauthier-Villars * 1982.

A detailed study of the distribution of a number of trace elements in Baffin Bay has been carried out. The principal water fluxes have been characterised. For each metal studied, higher concentrations are found in Arctic Ocean surface water advected through Lancaster Sound and Jones Sound than water flowing through Smith Sound. Vertical profile sampling has shown that for each element, surface concentrations are equal to or exceed levels at depth. No surface layer depletion resulting from biological uptake was observed for Ni, Cu or Cd. Elevated levels of certain metals from the melting of glacier ice and sea ice, notably Fe, Cu and Cd, and the input of metals from the Arctic Ocean via Lancaster and Jones Sounds may mask any uptake in this low production zone. In subsurface waters concentrations of trace metals are constant with depth and at comparable levels to those reported in pelagic areas.

F11821
CAREY JH, FOX ME, BROWNLEE BG, METCALFE JL, MASON PD, YEREX WH * **Devenir et effets des contaminants des eaux du ruisseau Canagagigue. 1. Ecologie du cours d'eau et identification des principaux contaminants** * Ser sci Etude no 135 * 38p * Environ Can, Inst natl rech eaux, Dir gen eaux inter, Cent can eaux inter, Burlington, Ont * 1983.

Pour etudier les organismes vivant dans le ruisseau Canagagigue, on a fait le prelevement saisonnier du poisson et du benthos en six stations situees entre le reservoir Woolwich et le confluent de la riviere Grand en Ontario. On traite des tendances de l'abondance et de la diversite des especes et on a determine un indice de diversite de la faune benthique a chaque station. Chez le poisson et le benthos, l'abondance et la diversite des especes decroissent en aval du point de contamination. A la station la plus en aval, l'auto-epuration du ruisseau est presque complete comme en temoignent l'abondance et la diversite des especes. Pour ce qui est des contaminants organiques de synthese, on a decele des chlorophenols, des benzothizoles et du lindane, a concentrations elevees, en aval d'Elmira, comparativement aux concentrations en amont. On a aussi constate qu'un ensemble de composes acides indetermines s'etait forme dans l'usine d'epuration de Woolwich/Elmira, a partir de precurseurs inconnus. La concentration de tous les contaminants observes a notablement diminue vers l'aval, en raison de la distance. On a constate que les chlorophenols s'etaient accumules chez le benthos et le poisson. L'etude servira de base a un examen fouille des mecanismes de l'accumulation et de la degradation des contaminants mentionnes dans le ruisseau.

065471
CARPENTER JW, GREEN RH, PATERSON CG * **A preliminary organic carbon budget for a small dystrophic lake in Maritime Canada** * Hydrobiologia * 106(3) 275-282 * 1983-10-07.

The results of a preliminary organic budget for a small (1.13 h) dystrophic lake in Maritime Canada are presented. Wood's Pond is moderately autotrophically productive (395 mg C per s m per day). Allochthonous inputs overwhelmed autochthonous production by an approximate ratio of 9.7:1. Seepage through the surrounding Sphagnum mosses accounted for 89.9% of all organic carbon entering the lake while fluvial transport was responsible for over 90% of losses. The yearly balance was a net loss of approximately 1820kg C. The marked dominance of allochthonous inputs over autochthonous production obviously influences the physico-chemical limnology of Wood's Pond but it does not necessarily follow that this system is heterotrophic. The yearly autotrophic production, approximately 1466 kg C, essentially balances an annual community respiration and insect emergence of 1481 kg C. This suggests that, at least in theory, the biological functioning of this dystrophic lake system could be driven almost entirely by autotrophic production.

065776
CHANTLER AG * **Settling ponds at Line Creek coal mine, British Columbia** . IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * v2 599-613 * Can Soc Civ Eng * (1983).

The design of settling ponds to treat

runoff from an open pit coal mine in a mountainous area of British Columbia is described and discussed. The requirements of the various Provincial agencies are outlined, in particular those of the Ministry of Environment which were developed concurrently with the design. The theoretical basis for pond design is presented along with a practical alternative approach for use when there is inadequate knowledge of the design parameters, as in this case. The ponds were designed as several series of ponds separated by lateral dykes. They are capable of treating the 10 year 24 hour flood flow and withstanding a 200 year event.

063635
CHARLTON MN * **Downflux of sediment, organic matter, and phosphorus in the Niagara River area of Lake Ontario** * J Great Lakes Res * 9(2) 201-211 * 1983.

Vertical arrays of sediment traps were installed near the mouth of the Niagara River and at nearshore and offshore sites. Surveys of temperature, turbidity, and conductivity were used to establish that the traps nearest the river mouth were under the river outflow plume. A single offshore array in 1980 indicated downfluxes of 1-2 g. pe sq m per day of dry matter in the mid-water column. These fluxes were similar to those of small lakes but much higher fluxes were found near the bottom of Lake Ontario. More extensive work in 1981 confirmed the presence of a near-bottom nepheloid layer and the effect it has on increasing downflux extimates. Sediment traps near shore and at the river mouth caught substantially more material at all depths than did traps at offshore stations. Downfluxes of phosphorus and sediment were consistent with independent estimates of loading and retention.

062249
CHARLTON MN, RAO SS * **Oxygen depletion in central and eastern Lake Erie: relationship with bacteria, chlorophyll, POC, and morphometry** * J Great Lakes Res * 9(1) 3-8 * 1983.

Hypolimnion oxygen depletion in central and eastern Lake Erie was related to bacteria, particulate organic carbon, and chlorophyll concentrations during 1979. The central basin had the higher oxygen depletion rate and this was associated with more microbiota and particulate organic carbon. After compensation for temperature differences, the rate of oxygen depletion per unit bacteria, chlorophyll, and particulate organic carbon was found to be similar in each basin. These observations are consistent with the hypothesis that lake morphometry affects oxygen depletion through the control of hypolimnion particle concentrations. The implication that most of the hypolimnion oxygen metabolism occurs in the water column means that the role of sediments as a site of oxygen consumption should be reassessed.

F10875
CHAU ASY * **Importance des etalons de reference dans la verification de l'exactitude des resultats d'analyses environnementales** * Bull qual eaux * 8(1) 27-31 * Environ Can; Cent can eaux inter, Burlington, Ont * 1983-03.

Les donnees analytiques sont des outils essentiels pour evaluer l'environnement et lutter contre la pollution, en vue d'assurer la qualite du milieu naturel. Pour s'assurer de l'exactitude des donnees, il faut des programmes efficaces qui devraient faire partie integrante de l'analyse, de l'interpretation des resultats et des decisions dans le cadre des programmes de protection de l'environnement et de lutte contre la pollution. Les etalons de reference constituent un element essentiel de tout le programme de verification des resultats des analyses qui se veut efficace. Ils servent a etablir la compatibilite et la fiabilite des donnees obtenues lors d'etudes de surveillance ou de controle auxquelles participent plusieurs organismes.

061935
CHAU ASY * **Standard Reference Materials in environmental quality assurance** * Water Qual Bull * 8(1) 26-29, 53-54 * Who Collab Cent Surf Ground Water Qual, [illegible] Cent Inland Waters, Burlington, Ont * 198[illegible]

This paper discusses [illegible] two classifications of environmental quality assurance, the intralaboratory and the interlaboratory quality assurance programs, and Standard Reference Materials (SRMs) and Reference Materials (RMs). The development and application of SRMs are one of the most important activities in an effective quality assurance program. The intralaboratory quality assurance program is a continuing and systematic regimen carried out by each analytical laboratory. It is the first step to ensure the quality of data generated. The interlaboratory quality assurance program is conducted by an outside agency to assist analytical laboratories to generate reliable data, to assess their overall laboratory performance and to ensure reliability and compatibility of data generated. SRMs are stable, homogeneous and well-characterized reference material prepared in quantity having essentially identical or very similar matrix to the test samples in order to eliminate or minimize matrix effect between reference and test samples. The importance of SRMs is discussed and the SRM program at the National Water Research Institute is described. One application by NWRI of one SRM and one RM for PCBs in sediment is described. Analytical data are essential tools for environmental assessment and pollution control to ensure a healthy environment, and effective quality

assurance programs are needed to ensure data quality. They should be an integral part of analysis, data interpretation and decision making in programs for environmental protection and pollution control.

066508
CHAU YK, MAGUIRE RJ, WONG PTS * **Alkyltin compounds in the aquatic environment** . IN: Proc 9th Annu Aquatic Toxicity Workshop, 1-5 Nov 1982, Edmonton, Alta * MACKAY WC * Can Tech Rep Fish Aquat Sci 1163 * p204 * Fish Oceans Can, Fish Habitat Manage Branch, Ottawa, Ont K1A 0E6 * 1982-11.

Alkyltin compounds are extensively used in industrial and agricultural applications. The results of our studies indicating (1) methylation of tin compounds, (2) occurrence of methyltin and butyltin species in environmental samples, and (3) organotin compounds being more toxic than inorganic tins would have significant environmental consequences.

065694
CHAU YK, MAGUIRE RJ, WONG PTS, GLEN BA, BENGERT GA, TKACZ RJ * **Occurrence of methyltin and butyltin species in environmental samples in Ontario** * Natl Water Res Inst Unpublished Manuscr #84-01 * 26p * Environ Can, Natl Water Res Inst, Inland Waters Dir * 1984-01.

During fiscal years 1982-1983 and 1983-1984 the Great Lakes Water Quality Program provided funding for a survey to determine the extent of contamination of waters on the Canadian side of the Great Lakes basin by methyltin and butyltin compounds. This is the report of the results of analyses of water, sediment and fish from about one hundred locations, largely in Ontario. Butyltin species were widely found in water and sediment samples. The highest concentrations were in harbours, reflecting the use of tri-n-butyltin as an antifouling agent in boat paint. Methyltin species were infrequently detected, and their occurrence was correlated with the presence of relatively high concentrations of inorganic tin.

062392
CHAU YK, WONG PTS, BENGERT GA * **Determination of methyltin(IV) and tin(IV) species in water by gas chromatography/atomic absorption spectrophotometry** * Anal Chem * 54(2) 246-249 * 1982-02.

The highly polar and solvated methyltin, dimethyltin, trimethyltin, and Sn(IV) species are extracted into benzene containing tropolone from water saturated with sodium chloride. These compounds are butylated in the extract to the tetramethylbutyltins, MesubnSnBusub4-n, which have sufficient volatility to be separated and analyzed by the GC-AAS system. Large volumes of water sample can be handled. Under normal laboratory conditions, detection limit of 0.04 micro g/L can be achieved with 5 L of water sample. Absolute detection limit of the GC-AAS for Sn is 0.1 ng. Volatile organotin compounds such as Me4Sn and methyltin hydrides can also be analyzed by this method.

062107
CHAU YK, WONG PTS, KRAMAR D * **The determination of dialkyllead, trialkyllead, tetraalkyllead and lead(2) ions in water by chelation/extration and gas chromatography/atomic absorption spectrometry** * Anal Chim Acta * v 146 211-217 * 1983.

The highly polar and solvated dialkyllead, trialkyllead and lead(II) ions are quantitatively extracted into benzene from aqueous solution after chelation with dithiocarbamate. The lead species are butylated by Grignard reagent to the tetraalkyl form, R (sub n) Pb Bu (sub 4-n) (R = CH3 or C2H5) and Bu4Pb, all of which can be quantified by a gas chromatography-atomic absorption spectrometry method. Molecular covalent tetraalkyllead species, if present in the sample, are also extracted and quantified simultaneously. A detection limit of 0.1 per micro g lead can be achieved with one litre of water. Other metals co-extracted by the chelating agent do not interfere.

062246
CHEN RL, KEENEY DR, MCINTOSH TH * **The role of sediments in the nitrogen budget of lower Green Bay, Lake Michigan** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

062989
CHOO-YING AV * **Cookstown - Innisfil Creeks water quality survey 1980** * 30p * Ont Minist Environ * 1982-01.

The Cookstown-Innisfil Creeks Water Quality Survey, 1980 was carried out to establish the existing water quality in the basin. Prior to this survey, there was little or no information on either water quality or stream flow rates. This report will provide background information to set preliminary guidelines for the treated effluent from a proposed water pollution control plant to service the Village of Cookstown. The proposed outfall for the water pollution control plant will be on either Cookstown Creek or Innisfil Creek; the exact location is unknown as the application for approval of this facility has not yet been received by this Ministry. The Village of Cookstown is at the intersection of the Townships of Tecumseth, West Gwillimbury, Innisfil and Essa, i.e., at the intersection of Highway No. 89 and Highway No. 27. This report will indicate the availability of flows at two stream locations, one on Cookstown Creek and the other on Innisfil Creek. The stream

sections surveyed were Cookstown Creek and Innisfil Creek to the first concession downstream of the Cookstown Creek.

063446
CHOW-FRASER P, DUTHIE HC * **Assessment of phosphorus limitation in an oligotrophic lake using radiophosphorus uptake kinetics** * Can J Fish Aquat Sci * 40(6) 817-821 * 1983-06.

We used 32P uptake kinetics as a means of assessing periods of P limitation to phytoplankton growth in an ultraoligotrophic lake. Tracer experiments, conducted biweekly and weekly in 1975 and 1976, respectively, yielded information regarding the availability of phosphorus over the sampling seasons. Analytical measurements of ambient phosphorus concentrations were not as informative as uptake kinetic data in the assessment of phosphorus demands in the lake. Whereas analytical methods identified probable periods of P limitation at the end of summer, radiophosphorus data indicated that P limitation was prevalent throughout most of the summer.

059132
CHURCHLAND LM * **Fraser River estuary study water quality, microbial water quality, 1970-1977** * 144p * Gov Can, Prov BC * 1980-01.

Fecal coliform data collected by various government agencies and the university community between 1970 and 1977 were reviewed. In order to organize and compare data from different areas of the Fraser River estuary, over one hundred sampling sites were grouped into 22 river reaches. The data were generally presented as annual geometric mean values, 10th and 90th percentiles, and compared with the relevant use criteria for each reach. Certain special data collection programs were conducted to study specific problems associated with the design of a monitoring program. These included investigations of variability on cross sections of the river, through tidal cycles, and between days of the week. The data indicated an obvious improvement in microbial water quality subsequent to the start-up of the Annacies Island sewage treatment plant in 1975. Chlorination of sewage treatment plant effluents during the summer reduced fecal coliform counts below winter levels and provided acceptable water for irrigation and swimming at Spanish Banks beaches, adjacent to the study area. It was concluded that because of the diversity of inputs, which include storm sewers and upstream sources, the elimination of bacteriological contamination of molluscan shellfish in the estuary was not presently feasible. A rough comparison of coliform loadings from sewage treatment plant (STP) effluents, storm sewer effluents, and the Fraser River upstream of the study area indicated that STP effluents are the principal source of coliform bacteria during hte non-chlorinating months. Further studies would be required to identify relative contributions from these three major sources during chlorinating months.

061826
CLAIR T, NORTON G * **Regeneration of lake sediment aluminum and phosphorus at varying pH's, Appendix 1** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

066606
CLAIR TA, ENGSTROM DR, WHITMAN * **Water quality of surface waters of Newfoundland and Labrador, data report** * IWD-AR-WQB-82-32 * 55p * Environ Can, Inland Waters Dir, Atl Reg, Water Qual Branch, Moncton, NB E1C 8N6 * 1982-11.

This report presents all data collected by the Water Quality Branch (WQB), the University of Minnesota and the Canadian Wildlife Service (CWS) surveys in Newfoundland and Labrador from 1979 to 1981 and used in Clair and Engstrom (in press). All WQB and CWS samples were analysed using standard WQB techniques described in the Analytical Methods Manual (1979) and are described in Table I. The methods used by the University of Minnesota are shown in Table II. All the data here is located on the National Water Quality Data System (NAQUADAT), Water Quality Branch, Environment Canada, Ottawa. Most of the parameters reported are self-explanatory. However, the Calcite Saturation Index (CSI) is also used as an index of water sensitivity to acid precipitation. The index uses alkalinity as well as calcium concentrations, ionic strength and pH values of the water to give a relative indication of the water's sensitivity. Sea-salt corrections for sulfate, calcium, magnesium and sodium were calculated using Chloride as a basis for the calculations.

062051
CLAIR TA, WHITFIELD PH * **Trends in pH, calcium, and sulfate of rivers in Atlantic Canada** * Limnol Oceanogr * 28(1) 160-165 * 1983-01.

Acid precipitation is affecting the chemistry of rivers in Atlantic Canada. Long term records for pH, calcium, and sulfate from 11 rivers were fitted using time series models. Decreases in pH over time were found, but the results for calcium and sulfate were not consistent with the predicted model. The conceptual models used to understand the effects of acid precipitation on water chemistry did not adequately explain the observed changes.

F10740
CONS NATL RECH CAN * **Polychlorodibenzo-p-dioxines: limites des methodes analytiques actuelles** * CNRC no 18577 * 186p * Cons natl rech Can, Ottawa, Ont * 1982.

L'on soupconne actuellement que les polychlorodibenzo-p-dioxines (PCDD) se trouvent partout dans les ecosystemes aquatiques et terrestres en Amerique du Nord. Il existe 75 PCDD differentes, dont certaines, telle que la 2,3,7,8-dibenzo-p-dioxine, sont extremement toxiques, et d'autres sont, pretend-on, relativement anodines. Puisqu'un examen des implications de ces constatations s'impose, le Comite associe du CNRC sur les criteres scientifiques concernant l'etat de l'environnement a convoque deux groupes d'experts internationaux afin d'examiner (1) les questions de base sur les quantites, les sources, les routes, la persistence et la toxicite des PCDD dans l'environnement et (2) l'efficacite des methodes visant a detecter, identifier et mesurer les PCDD. Leurs resultats sont publies dans deux documents qui viennent de paraitre. Le premier, portant le titre "PCDD: criteres relatifs a leurs effets sur l'homme et son environnement", examine les sources des PCDD qui entrent dans l'environnement au Canada, et presente une analyse de la persistence et du sort de la 2,3,7,8-tetrachlorodibenzo-p-dioxine. En outre, le document etudie les criteres disponibles permettant d'evaluer les effets toxiques des dioxines en general. Selon le groupe d'experts, ce qui importe c'est l'exposition de l'homme a toutes les PCDD, et non simplement a la 2,3, 7,8-dibenzo-p-dioxine. Dans ce contexte, ils ont examine les exigences d'une evaluation et ont recommande des etudes visant d'un part a determiner si l'homme est moins sensible aux PCDD que les animaux en laboratoire, et d'autre part a elucider le sort des melanges de dioxines dans l'environnement. Les auteurs remarquent qu'a present, avec les techniques traditionnelles pour etablir le caractere inoffensif d'une substance chimique, on n'est pas encore a meme de demontrer au laboratoire que les chlorophenols (parmi les sources principales des dioxines) sont anodins. On fait des suggestions pour resoudre ce dilemme. Dans le deuxieme document, intitule "PCDD: limites des methodes analytiques actuelles", on examine et evalue l'efficacite de 56 techniques pour analyser les polychloro-p-dioxines et on traite des problemes de separation, d'interferences potentielles, et de sensibilite. D'ailleurs, on examine egalement la situation actuelle quant aux methodes bioanalytiques et aux exigences de securite au laboratoire. Les auteurs soulignent qu'on est parvenu a separer la 2,3,7,8-tetrachlorodibenzo-p-dioxine des 21 autres isomeres seulement en 1979 et que, les methodes de separation etant si longues et complexes, on devait souvent recourir aux confirmations moins rigoureuses quant au depistage. Ils nous avertissent que les analyses des echantillons, souvent pris au hasard, donnent des resultats qui peuvent ne pas etre representatifs de la repartition des contaminants.

O65078
COSTELLA AC, NIDLE B, SHORTREED KS * **Limnological results from the 1982 British Columbia Lake Enrichment Program** * Can Manuscr Rep Fish Aquat Sci 1706 * 232p * Dep Fish Oceans, Fish Res Branch, West Vancouver Lab, 4160 Marine Dr, West Vancouver, BC V7V 1N6 * 1983-06.

Results of the 1982 Limnology subprogram of the British Columbia Lake Enrichment Program (LEP) are presented. Twenty-four stations in 17 lakes were sampled from near-isothermal conditions in spring until fall overturn. Major inlet streams and outlets of two lakes were also sampled. Data are presented for each lake, station and date and summarized in the summary tables. Time-weighted means for the growing season are also included.

O65543
COSTELLA AC, NIDLE B, SHORTREED KS * **Limnological results from the 1981 British Columbia Lake Enrichment Program** * Can Manuscr Rep Fish Aquat Sci 1693 * 282p * Dep Fish Oceans, West Vancouver Lab, West Vancouver, BC * 1983-01.

Results of the 1981 Limnology subprogram of the British Columbia Lake Enrichment Program (LEP) are presented. Twenty-five stations in 13 lakes were sampled from near-isothermal conditions in spring until fall overturn. Major inlet streams and outlets of four lakes were also sampled. Data are presented for each lake, station and date and summarized in the summary tables. Time-weighted means for the growing season are also included.

F10445
COUILLARD D * **Geologie et geochimie du fleuve, de l'estuaire et du golfe Saint-Laurent (Canada)** * J can sci terre * 19(7) 1492-1506 * 1982-07.

Cet article donne pour le fleuve, l'estuaire et le golfe Saint-Laurent (Quebec, Canada) un apercu de la qualite de la phase solide et en particulier des sediments de fond. Dans le fleuve, la concentration des solides en suspension varie de 4 a 10 mg par L pour la partie en amont du lac Saint-Pierre et de 30 a 50 mg par L dans la partie en aval du lac jusqu'a Quebec. A l'exception du delta de Sorel, cette section du fleuve ne constitue pas de fosses a sediments importantes; toutefois, l'enrichissement des sediments de surface en phosphore, biphenyls polychlores, cuivre et plomb est important. La partie immediatement en amont de l'ile d'Orleans ou se melange l'eau douce du fleuve et l'eau salee du golfe, constitue une zone de fortes concentrations (jusqu'a 300 mg par L) de

solides en suspension. Les processus de sedimentation dans l'estuaire sont compliques par la coagulation des particules fines au contact des eaux salees. Il en resulte que la zone immediatement en amont de l'ile d'Orleans constitue une fosse a sedimentation importante qui necessite de constants dragages. Ces sediments fins sont riches en phosphore, matieres organiques et en biphenyls polychlores. Dans cette region, le profil des sediments en suspension est globalement caracterise par une concentration decroissante de l'ile d'Orleans (40-80 mg par L) jusqu'au golfe Saint-Laurent (1-2 mg par L).

F11194
COUILLARD D * **BPC et pesticides organochlores dans le systeme Saint-Laurent** * Rev can ressources eau * 8(2) 32-63 * Assoc can ressources eau * 1983.

Les pesticides organochlores et les biphenyles polychlores (BPC) font partie des produits les plus toxiques repandus dans l'environnement. Ce travail de synthese, base sur une revue bibliographique approfondie a comme but de regrouper et d'etudier les differents travaux portant sur les teneurs en composes organochlores pour le fleuve, l'estuaire et le golfe Saint-Laurent, afin de presenter un apercu des concentrations pour le systeme global du Saint-Laurent (fleuve, estuaire et golfe). L'etude des concentrations de ces substances dans l'eau, les sediments et les poissons (quelques mollusques pour l'estuaire) du systeme Saint-Laurent montre que la section du fleuve Saint-Laurent en amont de l'Ile d'Orleans est plus contaminee que la section situee en aval. En particulier, le troncon de Montreal ainsi que les lacs Saint-Louis et Saint-Francois sont les secteurs les plus contamines de tout le territoire etudie. Dans cette section du fleuve Saint-Laurent, les poissons (11 especes) sont tres contamines; leur chair contient jusqu'a 15 ppm de BPC et depasse la norme gouvernementale de 2.0 ppm pour la consommation. Pour l'estuaire et le golfe Saint-Laurent, les concentrations des produits organochlores et des BPC sont assez uniformes et inferieures a celles mesurees dans le fleuve en amont de Quebec. L'analyse de la chair de 9 especes de poissons echantillonnes dans l'estuaire revele que les teneurs en produits organochlores sont peu elevees et que seuls les BPC depassent parfois la norme de 2 ppm pour l'estuaire.

064689
CROSS PM, RIGLER FH * **Phosphorus and iron retention in sediments measured by mass budget calculations and directly** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

065123
CULLEY JLB, BOLTON EF * **Suspended solids and phosphorus loads from a clay soil: II. Watershed study** * J Environ Qual * 12(4) 498-503 * 1983-10.

Clay soils are very important agriculturally in southwestern Ontario, and they constitute a large proportion of the Canadian Lake Erie drainage basin. Analysis of water quality and quantity from a typ cal clay watershed indicated that estimates of suspended solids load varied substantially, depending on the calculation method; this was not the case for P. Effluent from subsurface drains was estimated to constitute about 60% of annual runoff from the watershed. About 32 and 18% of the suspended solids load was probably derived from bank erosion and subsurface drainage, respectively. Contribution of P from these sources was also substantial. Sediment delivery of eroded soil from cropland was estimated to be about 7% of the sheet and rill erosion rate.

065124
CULLEY JLB, BOLTON EF, BERNYK V * **Suspended solids and phosphorus loads from a clay soil: I. Plot studies** * J Environ Qual * 12(4) 493-498 * 1983-10.

Phosphorus and suspended solids (SS) contents in tile discharge from two southwestern Ontario clay soil drainage experiments were measured over a 2-y period. For continuous corn (Zea mays L.) plots, loads of SS and total P were 407 and 0.88 kg per ha per y, respectively. Suspended solids and total P loads from drains beneath permanent sod were 97 and 1.85 kg per ha per y, respectively. Comparison of these results with limited data on P and SS loads in surface runoff indicated that greater than 50% of the total P load from these nearly level plots may be lost via subsurface tile flow. Overall, 34% of the total P load from subsurface drains was sediment-associated. Furthermore, crop cover, P fertilization rate, and tile drain depth were found to significantly affect dissolved P export. Dissolved P concentrations in effluent from permanent bluegrass sod exceeded those from continuous corn and rotational plots. Subsurface sediment and sediment-associated P loads were highest from continuous corn. Greater soil cover over the tile line decreased both sediment and P concentrations. Sediment-associated P concentrations increased with P fertilization rate at one of the experimental locations.

F11760
DELISLE C * **Ecosysteme et toxicite** * 113-126 * Ecole polytechnique de Montreal, Que * 1981-01.

Le premier volet de ce document rappelle les principales definitions associees a l'ecologie et a l'environnement. Le deuxieme

volet s'attache plus specifiquement a l'ecologie aquatique; l'auteur aborde les aspects suivants: l'etablissement d'un programme de releves en ecologie aquatique, les organismes dits indicateurs en ecologie aquatique, la zonation d'une riviere recevant des affluents pollues, et l'indice de Shannon (indice de diversite). Le dernier volet s'interesse aux toxiques et illustre certains phenomenes de contamination du milieu par les metaux lourds.

063731
DELISLE CE * **Overview of mercury contamination in the environment of the province of Quebec** * Can Transl Fish Aquat Sci 4972 * 59p * Environ Can, Environ Prot Serv, Ottawa, Ont K1A OH3 * 1983.

An overview is given of mercury concentrations in the 303 drainage basins of Quebec, as well as in other components of the environment, such as land fauna. Data are presented in map form with short comments, and details of the data are included in appendices.

063730
DELISLE CE * **Overview of mercury contamination in the Quebec environment, Appendices** * Can Transl Fish Aquat Sci 4986 * 123p * Fish Environ Can, Environ Prot Serv, Ottawa, Ont K1A OH3 * 1983.

Sixteen appendices contain data relating to mercury in Quebec water drainages, including a number of analyses, recorded averages, minima and maxima, and bibliographical references.

F12178
DEMAYO A, TAYLOR MC * **Lignes directrices concernant la qualite des eaux de surface, Vol. 1 Les substances chimiques inorganiques, le cuivre** * 61p * Environ Can, Dir gen eaux inter, Dir qual eaux, Ottawa, Ont * 1983.

On a effectue une etude de la documentation portant sur les effets toxiques du cuivre et de composes du cuivre sur les humains, les organismes aquatiques, les plantes et le betail. Ces donnees sont resumees dans cette publication. En se basant sur ces donnees, on propose des valeurs des concentrations maximales de cuivre dans l'eau auxquelles on n'observe pas d'effets toxiques.

F12183
DEMAYO A, TAYLOR MC, REEDER SW * **Lignes directrices concernant la qualite des eaux de surface, Vol. 1 Les substances chimiques inorganiques, le selenium** * 21p * Environ Can, Dir gen eaux inter, Dir qual eaux, Ottawa, Ont * inconnu.

On a effectue une etude de la documentation portant sur les effets toxiques du selenium et des composes du selenium sur les humains, les organismes aquatiques, les plantes et le betail. Ces donnees sont resumees dans cette publication. En se basant sur ces donnees, on propose des valeurs des concentrations maximales de selenium dans l'eau auxquelles on n'observe pas d'effets toxiques.

F12180
DEMAYO A, TAYLOR MC, REEDER SW * **Lignes directrices concernant la qualite des eaux de surface, Vol. 1 Les substances chimiques inorganiques, l'arsenic** * 13p * Environ Can, Dir gen eaux inter, Dir qual eaux, Ottawa, Ont * 1982.

Les auteurs ont passe en revue la documentation existante sur les effets toxiques de l'arsenic et des composes de l'arsenic sur les etres humains, les organismes aquatiques, les plantes et le betail. L'information recueillie est resumee dans la presente publication et les auteurs en tirent des recommandations relatives aux concentrations maximales d'arsenic dans l'eau, en deca desquelles on n'observe aucun effet toxique.

064539
DERKSEN G * **Water quality and periphytic algal standing crop of the Capilano and Seymour Rivers, North Vancouver, British Columbia** * Reg Program Rep No 81-21 * 43p * Environ Prot Serv, Environ Prot Branch, Pac Reg, Environ Can * 1981-12.

The Capilano salmonid hatchery did not appear to have an appreciable effect on the dissolved oxygen, pH, temperature, or total organic carbon content of the Capilano River. Elevated levels of nitrate and ammonia were found to be significantly greater downstream of the hatchery during certain times of the year. The high detection limit for phosphorus was not adequate to monitor the influence of the hatchery on that component. The standing crop of attached algae, measured as ug chlorophyll - a/sq cm was greater downstream of the hatchery. The highest standing crop values on the Capilano River were found immediately downstream of the hatchery through the spring to early summer. However, during the late summer and early fall, the standing crop at the more downstream station increased above that of other stations on the Capilano River and those on the Seymour River. The water quality of the Seymour River was found to be similar to that of the Capilano River control station.

064538
DERKSEN G * **The impact of sewage disposal on the water quality and standing crop of plankton in Lynx Lake** * Reg Program Rep No 81-19 * 31p * Environ Prot Serv, Environ Prot Branch, Pac Reg, Environ Can * 1981-12.

Water chemistry and biological indices did not indicate that the domestic sewage effluent entering Lynx Lake through an unnamed creek

was having a detectable effect. It is theorized that nutrient regeneration within this type of small lake is a natural occurrence and, as evidenced in Erickson Lake, the control lake, can support algal blooms of 100 ug/l chlorophyll-a. Although blue-green algae made up a dominant portion of the phytoplankton in both lakes, the overall variety of phytoplankton was greater in Lynx Lake. Zooplankton standing crop was also greater in Lynx Lake and this may be attributed to the more diverse phytoplankton flora. It is felt that owing to the naturally high productivity of these lakes and the development of anoxic conditions during the late summer, fish habitation would be restricted to the upper region of the water column.

063902
DERKSEN G * **The effects of a sewage lagoon effluent on the water quality of the Cowichan River during the 1980 low flow period plus an evaluation of the lagoon's bacteriological reduction performance and effluent toxicity** * Reg Program Rep No 82-5 * 83p * Environ Prot Branch, Environ Prot Serv, Pac Reg, Environ Can * 1981-11.

The water quality of the Cowichan River was monitored over the summer low flow period of 1979 and 1980. During August and September, 1980 the impact of the Duncan-North Cowichan sewage discharge was monitored. The discharge dramatically increased nutrient levels in the river and stimulated a large algal bloom. Intragravel dissolved oxygen levels were significantly lower downstream of the outfall in August and September, 1980. An onsite flow-through bioassay showed the effluent to be non-toxic to resident juvenile coho salmon. The lagoon system provided adequate disinfection to reduce fecal coliform levels and no significant water quality deterioration in the river with respect to fecal coliforms was found. Nutrient control considerations are discussed.

F11514
DESROCHERS R * **Effets de l'aeration de la riviere Magog sur l'eutrophisation du lac Magog** * 38p * Univ Sherbrooke * 1983-01-07.

Le lac Magog presente tous les indices d'un lac en etat assez avance d'eutrophisation. Cet etat serait attribuable, en partie, a l'apport de substances polluantes deversees par la riviere Magog dont la DBO a la station 5, juste en amont du lac Magog, est la plupart du temps superieure a 4. Des substances nutritives proviennent egalement des fermes situees dans le bassin du lac et aussi des nombreuses residences en bordure du lac. L'aeration avait pour but d'accelerer la decomposition de la matiere organique presente dans les eaux de la riviere Magog et de maintenir le niveau d'oxygene eleve dans ces eaux. Si cette aeration est efficace, on devrait s'attendre a une augmentation de la teneur en oxygene, a une diminution de la DBO5 et a des changements dans la teneur en substances minerales suite a la decomposition de la matiere organique. On examine les effets de l'aeration sur l'oxygene dissous, sur la DBO, sur les substances minerales et sur l'eutrophisation.

062329
DOLAN DM, BIERMAN VJ * **Mass balance modeling of heavy metals in Saginaw Bay, Lake Huron** * J Great Lakes Res * 8(4) 676-694 * 1982.

During the period 1976-1978, a study of hazardous materials in Saginaw Bay was conducted. This study included the fate and distribution of cadmium, copper, lead, and zinc in the bay. A spatially segmented, dynamic mass balance model was developed to describe concentrations of metals and suspended solids in the water column and in the sediments. A wind-driven resuspension mechanism was used to describe the sediment-water interactions. The distribution of metals in the water column was determined by equilibrium partitioning between the ambient suspended solids and the dissolved phase. Model output was calibrated to field data for the principal variables. Independent validation was obtained by comparing partition between the ambient suspended solids and the dissolved phase. Model output was calibrated to field data for the principal variables. Independent validation was obtained by comparing partition coefficients from the calibration to those calculated directly from the field observations. It was found that suspended solids were important in controlling the water column concentrations of the metals. The degree of control was a function of the partition coefficient between the metal and the solids, and the concentration of the solids. Adsorption of the metals to the solids was found to result in decreases to metals concentrations due to net sedimentation, as well as increases due to wind-driven resuspension. On an annual average basis, the net flux of the particulate components of all four metals was from the water column to the sediments except for copper in 1977.

063774
DORCEY AHJ * **Strategies for coastal resource management in western Canada - while battles are being won, is the war being lost?, Chapter 14** (see chapter 4.10 for complete reference - voir chapitre 4.10 pour la reference complete)

066851
DREDGING SUBCOMMITTEE, GREAT LAKES WATER QUALITY BOARD * **1983 Report on Great Lakes water quality, appendix** * 35p * Int Jt Comm, Great Lakes Reg Off, 100 Ouellette Ave, Windsor, Ont N9A 6T3 * 1983-08.

This report contains a summary of the major findings, conclusions and recommendations of the Great Lakes Water Quality Board's Dredgng Subcommittee pertaining to the following projects: guidelines and register for evaluation of Great Lakes dredging projects; evaluation of dredged material disposal options for two Great Lakes harbours, Toronto and Toledo, using the Dredging Subcomittee's guidelines; Great Lakes dredging in an ecosystem perspective, Lake Erie; workshop on "Open-lake disposal site selection criteria development"; and, bioassessment of Toronto and Toledo Harbour sediments. In addition, conclusions are presented on investigation of in-place pollutants, beneficial uses of dredged materials, and impacts on wetlands from dredging activities in the Great Lakes. The report concludes that the Dredging Subcommittee has provided compatible guidelines for evaluation of dredging projects in the Great Lakes Basin and that the development of site-specific criteria for use in the areas of intensive and continued dredging activities requires updating of existing data and additional information. A membership list of the Subcommittee is included in the Appendix.

F11542
DUMAS JP, PAZDERNIK L * **Variations saisonnieres des composantes de l'alcalinite des eaux dans le Haut-Estuaire du fleuve Saint-Laurent (Quebec)** * Water, Air and Soil Pollut * 20(4) 413-424 * 1983-11.

Des prelevements furent effectues sur l'alcalinite totale des eaux de la riviere Saint-Laurent durant l'annee 1980-1981. Les analyses de l'alcalinite des carbonates, des borates, des phospates, des silicates et du pH ont permis l'evaluation de chacune de ces composantes. A la lumiere des resultats obtenus, on peut en deduire que les carbonates sont responsables en toutes saisons, pour plus de 96% de l'alcalinite du fleuve Saint-Laurent.

066573
DUNSTALL TG, SCHWARZ CJ * **Effects of temperature elevation and entrainment on heterotrophic uptake of (U-14C) glutamic acid** * Water Res * 17(12) 1847-1853 * 1983.

The effect of temperature elevation and station passage on the heterotrophic uptake of glutamate in condenser cooling water was investigated at three Ontario Hydro generating stations. Glutamate uptake increased approx. 1.9 times with a 10C rise in lakewater temperature providing the total (discharge) temperature did not exceed 30C. Above 30C inhibition of bacterioplankton activity was observed. Mechanical stress encountered during station passage resulted in a reduction of heterotrophic activity of approx. 57%. Temperature elevation and mechanical stress experienced during the once-through cooling process could be expected to result in a net increase in heterotrophic productivity, largely in peripheral areas of the effluent thermal plume and contiguous waters.

063633
DURHAM RW, OLIVER BG * **History of Lake Ontario contamination from the Niagara River by sediment radiodating and chlorinated hydrocarbon analysis** * J Great Lakes Res * 9(2) 160-168 * 1983.

Contamination of Lake Ontario by persistent organic compounds began with the development of the chemical industry along the Niagara River. These compounds are discharged to the river where they are scavenged from the water column by sedimenting particulates which in turn settle out in depositional areas of Lake Ontario. We have determined 210Pb, 137Cs, and chlorinated hydrocarbon profiles of sediment cores taken about 3 km from the mouth of the Niagara River. Age profiles of the sediments were constructed from the radionuclide measurements and used to determine historic trends of chlorinated hydrocarbon input to Lake Ontario. The historical record found in the sediments for chlorobenzenes, chlorotoluenes, hexachlorobutadiene, octachlorostyrene, mirex and PCBs is in good agreement with known production and usage patterns of the chemicals. Pollution of Lake Ontario with chlorinated hydrocarbons from the Niagara River is still occurring, but the worst contamination of the lake occurred in the 1960s.

062398
DUTKA BJ, KWAN KK * **Application of four bacterial screening procedures to assess changes in the toxicity of chemicals in mixtures** * Environ Pollut Ser A * v29 125-134 * Ripple Road, Barking, Essex, GB * 1982.

Four microbiological acute toxicity screening test methods with Microtox, Spirillum volutans, Pseudomonas fluorescens and Aeromonas hydrophila were compared using solutions of mixed toxic chemicals. Each toxicity screening test appeared to have its own sensitivity pattern and it would appear unwise to try to assess the presence of toxicants in waters or effluents by a single species test. The battery approach, encompassing two or three genera and involving two or four species, is recommended to assess the protential presence of toxicants more thoroughly.

065719
DUTKA BJ, NYHOLM N, PETERSON J * **Comparison of several microbiological toxicity screening tests** * Water Res * 17(10) 1363-1368 * 1983.

Four short-term microbiological toxicity screening tests were compared using the following test chemicals: 3,5 dichlorophenol, cetyl trimethyl ammonium chloride, sodium

lauryl sulfate, phenol, copper(II) sulfate, mercury(II) chloride and zinc(II) sulfate. These seven chemicals represent a wide range of toxicity. The methods examined were Beckman's Microtox system, the Spirillum volutans motility test, inhibition of respiratory activity sludge, and inhibition of activated sludge TTC-dehydrogenase activity. The results obtained indicate that each method has its own toxicity sensitivity pattern, and among the substances tested, only mercury(II) chloride and phenol were ranked equally by the four methods as the most and the least toxic chemical, respectively. In a tentative ranking of the methods, according to sensitivity, the Microtox test came out as the most sensitive test followed by the Spirillum test, which in turn appeared more sensitive than the two sludge tests. This ranking has meaning only in a statistical sense, however, and the variable nature of the results support the philosophy that for assessing toxicity more thoroughly, a battery of several tests is required.

066556
EADIE BJ, ROBBINS JA, LANDRUM PF, RICE CP, SIMMONS MS, MCCORMICK MJ, EISENREICH SJ, BELL GL, PICKETT RL, JOHANSEN K, ROSSMAN R, HAWLEY N, VOICE T * **The cycling of toxic organics in the Great Lakes: a 3-year status report** * NOAA Tech Memo ERL GLERL-45 * 163p * US Dep Commer, Nat Oceanic Atmos Adm, Environ Res Lab * 1983-05.

This interim 3-year status report describes the results of GLERL's studies on the cycling of toxic organics in the Great Lakes. A hierarchy of models has been developed including 1) a lakescale equilibrium model, 2) a one-dimensional steady-state model, 3) one- and two-dimensional time dependent models, and 4) several individual process models. These modeling efforts have identified process research needs, some of which have been supported. Reported here are results of our work on: 1) air-water exchange; 2) photolysis; 3) sorption and partitioning; 4) particle settling and transport; 5) early diagenetic processes in lake sediments; 6) interaction of sediments, contaminants, and benthic organisms; and 7) simulation studies of organic contaminants.

066149
EIDT DC, SOSIAK AJ, MALLET VN * **Partitioning and short-term persistence of fenitrothion in New Brunswick (Canada) headwater streams** * Arch Environ Cont Toxic * 13(1) 43-52 * 1984-01.

There were no consistent differences in concentration of fenitrothion in streamwater with depth, or between midstream and slow water at the stream edge. This was true of both aqueous and oil-based formulations. A large proportion of the fenitrothion was taken up by suspended material; in sediment, it was taken up mainly by the organic fraction. Concentrations of fenitrothion were above prespray values in most plants and insects sampled, and in some, above peak concentrations found in the water. Highest and most persistent residues were found in a liverwort. Highest residues in an animal were found in black fly larvae, perhaps explained by their filter-feeding on suspended matter with high fenitrothion concentrations. Peak concentrations in plants and animals usually occurred at 6 or 24 hr postspray sampling times, and in all cases decreased thereafter. Aminofenitrothion and fenitrooxon in sediments and 3-methyl-4-nitorphenol in plants and insects were seldom and inconsistently detected.

063039
EL-SHAARAWI AH * **Sampling strategy for estimating bacterial density in large lakes** , IN: Strategies de prelevement d'echantillons representatifs en microbiologie (eaux, sediments, surfaces), Compte-rendu colloq, 13 mai 1982, Metz, FR * J Fr Hydrol * 13(2) 171-187 * 1982.

The question of how to use past information about the spatial variability of bacteriological data to develop a strategy for future data collection is investigated when the lake can be divided into a number of (homogeneous) zones. A new method is given for forming the zones and determining the number of zones. Under the assumption that the number of bacteria found in successive, independent, and equal samples from each zone are identically distributed and that the objective of sampling is to estimate the mean bacterial density of the lake, a criterion is given which allows the optimal allocation of stations to zones. In particular, detailed analysis is made when the distribution of bacteria within each zone can be represented by a Poisson distribution. Further, the number of stations that need to be sampled in order to estimate the mean bacterial density of the lake with a pre-specified precision is given. The usefulness of the methods of this paper is illustrated using coliform data from Lake Erie.

063638
EL-SHAARAWI AH, ESTERBY SR, JUNTZ KW * **A statistical evaluation of trends in the water quality of the Niagara River** * J Great Lakes Res * 9(2) 234-240 * 1983.

Using water quality data collected at Niagara-on-the-Lake by the Water Quality Branch, Ontario Region, between 1975 and 1980, pH, alkalinity, total phosphorous, and nitrate concentrations are examined for changes over time. Moving averages, Spearman's rank correlation coefficient and regression methods, which model the seasonal cycle, are used. It appears that pH and alkalinity are decreasing, and nitrate increasing, but these

changes do not occur for all months. Since river discharge did not change significantly in any month, the changes in pH, alkalinity, and nitrate are not due simply to changes in discharge. A change in total phosphorous concentrations over years was not detected.

062496
ENNIS GL, NORTHCOTE TG, STOCKNER JG * **Recent trophic changes in Kootenay Lake, British Columbia, as recorded by fossil diatoms** * Can J Bot * 61(7) 1983-1992 * 1983-07.

Short sediment cores (ca.40 cm long) were collected from three locations within Kootenay Lake, B.C., and the occurrence of diatoms within the cores was recorded and analyzed. This analysis of fossil diatoms in the sediments of Kootenay Lake has provided evidence for environmental change as a result of man's activities in the drainage basin. Changes to the trophic status of the lake are related to operation of a phosphate fertilizer plant (beginning in 1953) on the major southern inlet river and to more recent water regulation on both the sourthern and northern major inlet rivers. Diatom numbers and volumes at the deeper core depths were lowest. Diatom species in the deeper core depths consisted of an assemblage of oligotrophic and eutrophic indicators corresponding to high (but not critically high) phosphorus loading to the lake. Above the 5-cm depth, numbers increased and peaked at the 3-cm depth in samples nearest the south end of the lake. At other locations within the lake, where sedimentation rates were lower, numbers peaked in the top centimetre of sediment. Concomitant with increased phosphorus loading diatom species indicative of oligotrophic conditions such as Cyclotella ocellata declined, while eutrophic indicators including Cyclotella glomerata, Melosira granulata v. angustissima, Stephanodiscus spp., Asterionella formosa, and Fragilaria crotonensis increased. Asterionella formosa and Fragilaria crotonensis showed highest abundances in the top 2 cm of the core. These species, which form a major component of the spring and fall diatom blooms, were responding to both increased nutrients and improved light conditions resulting from decreased freshet turbidity. The Araphidineae/Centrales ratio was not useful in classifying trophic changes in Kootenay Lake since numbers of centric diatoms did not decline with nutrient enrichments (although there was a dominance shift from oligotrophic centrics to eutrophic centrics). Shannon-Wiener diversity values remained high throughout the recent history of the lake.

062622
ENVIRON APPL GROUP LTD, TORONTO, ONT * **National inventory of natural sources and emission of mercury compounds** * 75p * Environ Can, Environ Prot Serv, Air Pollut Control Dir, Ottawa, Ont K1A 1C8 * 1981-07.

Among the more important mercury components within the atmosphere from natural sources are: elemental mercury, organomercury compounds and particulate mercury compounds. Promicipal emitting sources include soils, vegetation, forest and brush fires and marine waters. This report provides a first approximation of Canadian emissions of mercury compounds from natural sources. Due to differences in mercury emission rates and the lack of specific information, elemental mercury is regarded as the only compound to be emitted from land and marine sources to the atmosphere. All fluxes should consequently be regarded as order of magnitude approximations. Emission data are presented for each Canadian province using fluxes estimated from Canadian soil orders and various biome components. In addition, emissions for Canadian territorial waters have also been estimated. Annual emissions of mercury from natural sources are estimated to be 3.5 x 1,000,000 kg Hg. British Columbia, Northwest Territories and Quebec are the most productive regions for natural mercury releases. Emissions from vegetation and soils contribute to over 99% of the total. Approximately 11 x 1,000 kg Hg/yr are released from marine environments.

F11825
ENVIRON CAN * **Echantillonnage pour la qualite de l'eau** * 67p * Environ Can, Dir qual eaux, Dir gen eaux inter, Ottawa, Ont * 1983.

Le present ouvrage a ete concu afin d'aider le chercheur qui preleve des echantillons d'eau aux fins d'analyses. Y figure un resume des methodes utilisees et recommandees par la Direction de la qualite des eaux. Les recipients a echantillons, les agents de conservation et les methodes d'echantillonnage qui y sont decrits servent couramment aux analyses physiques, chimiques et bacteriologiques.

F12166
ENVIRON CAN * **Lignes directrices concernant la qualite des eaux de surface. Vol. 2 Les substances chimiques organiques, l'hexachlorobutadiene** * 12p * Environ Can, Dir gen eaux inter, Dir qual eaux, Ottawa, Ont * 1983.

On a effectue une etude de la documentation portant sur les effets toxiques de l'hexachlorobutadiene sur les humains, les organismes aquatiques, les plantes et le betail. Ces donnees sont resumees dans cette publication. En se basant sur ces donnees, on propose des valeurs des concentrations maximales d'hexachlorobutadiene dans l'eau auxquelles on n'observe pas d'effets toxiques.

F12179
ENVIRON CAN * **Lignes directrices concernant la qualite des eaux de surface, Vol. 1 Les**

substances chimiques inorganiques, l'uranium * 19p * Environ Can, Dir gen eaux inter, Dir qual eaux, Ottawa, Ont * 1984.

Une etude bibliographique des effets chimiques toxiques de l'uranium et de ses composes sur la sante, la vie aquatique, les plantes et le betail a ete realisee. Toute l'information recueillie est resumee dans le present document et, a partir de celui-ci, des recommandations sont faites concernant les concentrations maximales d'uranium dans l'eau pour eviter tout effet toxique.

F12167
ENVIRON CAN * **Lignes directrices concernant la qualite des eaux de surface, Vol. 2 Les substances chimiques organiques, les phtalates** * 25p * Environ Can, Dir gen eaux inter, Dir qual eaux, Ottawa, Ont * 1983.

On a effectue une etude de la documentation portant sur les effets toxiques des phtalates ou esters de l'acide benzenedicarboxylique-1,2 sur les humains, les organismes aquatiques, les plantes et le betail. Ces donnees sont resumees dans cette publication. En se basant sur ces donnees, on propose des valeurs des concentrations maximales des phtalates ou esters de l'acide benzenedicarboxylique-1,2 dans l'eau auxquelles on n'observe pas d'effets toxiques.

064873
ENVIRON CAN, ENVIRON PROT SERV, ENVIRON STRATEGIES DIR * **Environmental monitoring of federal and provincial projects, proceedings of a meeting held in Ottawa, January 26, 1982** * Econ Tech Rev Rep EPS 3-ES-83-2 * 124p * Environ Can, Environ Prot Serv, Environ Strategies Dir * 1983-03.

Environmental monitoring of Federal and Provincial projects is crucially important to any efforts to protect the environment, and to improving the effectiveness of the impact assessment process. Since monitoring is such a new field, this meeting was organized to exchange information. Discussion centred around presentations by the British Columbia and Ontario Ministries of Environment, and the Environmental Protection Service. Environmental surveillance is defined as inspections on a project by the proponent and by government, to ensure compliance with environmental terms and conditions. Administrative requirements for environmental surveillance are discussed, as well as requirements for standards and implementation needs. Environmental monitoring is defined as data collection and evaluation for the purpose of (1) determining the effectiveness of environmental protection measures; (2) developing a capability within government to anticipate or predict environmental change; and (3) improving on project management and related programs, to better protect the environment.

065801
ENVIRON CAN, NATL WATER RES INST * **National Water Research Institute, Analytical Methods Division, Annual study reports 1982/1983** * Natl Water Res Inst unpublished manuscr #83-1 * vp * Environ Can, Natl Water Res Inst, Inland Waters Dir * (1983).

This report is a compilation of year-end study progress reports of the Analytical Methods Division of the National Water Research Institute for the study year 1982-83. Reports are given for each of the division's four sections: Analytical Chemistry Research, Quality Assurance and Methods, Microbiology Laboratories, and Computer Sciences. Each report contains a study summary, significant findings, and the name(s) of the investigator(s). The reports are listed numerically to correspond to the order in the National Water Research Institute Directory of Study Forecasts.

F10627
ENVIRON CAN, SERV PROT ENVIRON, DIR GEN POLLUT EAUX, DIV PROD CHIM INORG IND * **Rapport sur l'observation du reglement sur les rejets de mercure par les fabriques de chlore et de soude caustique, en 1980-81** * Anal econ et tech, Rapp EPS 3-WP-83-2F * 16p * Environ Can, Serv prot environ, Dir gen lutte contre pollut eaux, Ottawa, Ont * 1983-02.

Le present rapport examine les resultats des moyens pris par l'industrie et les organismes gouvernementaux pour restreindre les rejets de mercure dans les effluents des fabriques de chlore du Canada. Des rapports semblables ont ete publies pour les annees 1975, 1976-1977 et 1978-1979. Les rejets de mercure dans les effluents se chiffrent actuellement a moins de 110 kg par annee, ce qui represente une reduction de plus de 99,8% depuis 1970. Les controles journaliers par les fabriques et les controles periodiques par les organismes federaux et provinciaux charges de l'environnement confirment cette reduction. La diminution considerable des achats et de la consommation de mercure depuis 1970 est attribuable a l'installation de systemes d'epuration efficaces, d'une meilleure recuperation du mercure des dechets solides et gazeux, de la fermeture d'usines ou de l'adoption de nouveaux procedes dans d'autres (10 au total). Seules des reductions mineures devraient desormais etre obtenues, etant donne que toutes les entreprises ont adopte les meilleures techniques de traitement et d'exploitation des electrolyseurs a cathode de mercure qui soient.

065626
ESSO MINERALS CANADA * **A reclamation plan for the Gays River lead/zinc mine** * 107p * Esso Minerals Canada * 1982-04.

This report presents a plan for reclamation of an area near Gay's River, Nova Scotia empacted by a lead/zinc mining and milling

operation. The plan is based upon regulatory requirements of the Nova Scotia Department specified in that province's "Environmental Protection Act", "Proposed Pit and Quarry Regulations" and "Information Requirements for Surface Mining Operations". The report contains a description of the mine operation, the existing environmental conditions affecting reclamation, land use status, and a discussion of the surface disturbances at Gay's River. Reclamation specifications, the rationale for the reclamation program and the procedure for reclamation monitoring are also described.

062815
EVANS HE, SMITH PJ, DILLON PJ * **Anthropogenic zinc and cadmium burdens in sediments of selected southern Ontario Lakes** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

066464
FED-PROV TECH WORK GROUP WATER QUAL OTTAWA RIVER * **Report of the Federal-Provincial Technical Working Group on Water Quality in the Ottawa River** * 29p * 1981-10.

The Federal-Provincial Technical Working Group on Water Quality in the Ottawa River reviewed nutrients, contaminants and bacteriology as they impact on the water quality conditions of the river. Although no major problems were discovered, deterioration of water quality in localized areas was recognized. In many instances, however, a lack of consistent, reliable data made it impossible to reach a definite conclusion as to the presence and significance of some contaminants. Significant decreases in phosphorus concentrations between 1972 and 1976 were recorded, due in large part to the effect of detergent phosphate limitations and to phosphorus removal in Ontario sewage treatment plants. Dissolved oxygen concentrations are generally acceptable. There have been decreases with time at Carillon and particularly at the Otto Holden Station. The rather sparse data on the trace metals and organics did not reveal any serious problems other than the well-documented presence of mercury which appears to be slowly diminishing, and possible elevated levels of PCB's downstream of Ottawa. There is bacteriological contamination in the Ottawa region due to municipal discharges and urban storm water runoff. Generally, the bacteriological quality is better in midstream than in near shore areas. The evaluation of the water quality was hampered by gaps and inconsistencies in the data due to a lack of coordination of monitoring programs and the recent discontinuation of some of the monitoring. The Working Group recommends that a coordinating committee be established, with representation from the governments of Canada, Quebec and Ontario. The committee would be responsible for reviewing data needs and overseeing the implementation of a coordinated monitoring plan in accordance with the available resources of the three agencies and would report annually to the Environment Ministers of the three governments. The Working Group also recommends that dissolved oxygen monitoring be reviewed on a priority basis, that pollution abatement efforts be continued with emphasis on biochemical oxygen demand reduction, and that the effects of agricultural imputs be evaluated in a special study.

066465
FED/PROV TECH WORK GROUP WATER QUAL OTTAWA RIVER, CONTAMINANTS TASK FORCE * **Report of the Contaminants Task Force of the Federal/Provincial Technical Working Group on Water Quality in the Ottawa River** * 23p * 1980-04.

This report on contaminants in the Ottawa River indicates, after examination of all available data, that a number of localized contaminant problems do exist although the river as a whole shows no sign of unusual contamination. It is found that: no problems exist with respect to trace metals contamination; PCBs are present in the river ecosystem; although no problem exists for acid rain from Lake Temiskaming to the south, the status of the Ottawa River north of the lake is at present undetermined; and, no problem presently exists with respect to radionuclide contamination of the river. Data on the presence of trace metals and persistent organic contaminants in water, sediments, biota and fish are presented. A brief account on the effects of acid rain on the Ottawa River basin is also included.

066466
FED/PROV TECH WORK GROUP WATER QUAL OTTAWA RIVER, MONIT PLAN TASK FORCE * **Report of the Monitoring Plan Task Force of the Federal/Provincial Technical Working Group on Water Quality in the Ottawa River** * 24p * 1981-09.

A monitoring plan which presents a basic framework for monitoring activities and is designed to provide the required information for the proper assessment of the water quality of the Ottawa River, is described. The plan presented determines the impact of man's activities on the quality of the river ecosystem in a coordinated and cost-effective manner which is required to meet the following objectives: determine existing water quality conditions; identify problem areas; assist managers in the design and implementation of remedial programs; and, determine water quality trends. The plan is carried out on the interprovincial section of the river between Dame-du-Nord and Carillon and is comprised of the following components: mainstem (water, sediment and fish); and,

inputs (tributaries, municipal, industrial, and non-point sources). Sampling locations, frequencies and procedures, the use of standard methods of analysis, quality control programs and conformance in data storage, retrieval, verification, analysis and utilization, are included in the program.

066467
FED/PROV TECH WORK GROUP WATER QUAL OTTAWA RIVER. NUTRIENT TASK FORCE * **Report of the Nutrient Task Force of the Federal/Provincial Technical Working Group on Water Quality in the Ottawa River** * 106p * 1980-05.

This report on nutrients, as one aspect in the study of water quality in the Ottawa River, examines past data, conducts an analysis of the data with subsequent interpretation, identifies problems related to nutrients, identifies data gaps, and provides recommendations and advice to the federal and provincial Ministers. The study found that: total phosphorus increased in a downstream direction from Temiscaming to Carillon; Ontario Environment data for 1971-1977 indicated a decrease in total phosphorus ranging from 20-50%; total phosphorus loads calculated for mainstem locations demonstrated decreases between 1972 and 1976; at the mouth of the Ottawa River, total phosphorus levels were higher than the water quality guidelines for total phosphorus; Ontario Environment data showed an increase in nitrogen concentration in a downstream direction between Temiscaming and Carillon and that this could be related to pulp and paper mill activities; total Kjeldahl nitrogen, total phosphorus, filtered ortho-phosphate, filtered nitrate and nitrite loads increased in a downstream direction; and, dissolved oxygen concentrations decreased during 1971-1977.

061827
FERG M * **A study of fecal coliform and fecal streptococcus densities in five British Columbia rivers** * 23P * 1980-08.

Fecal coliforms and fecal streptococci concentrations are determined in water samples collected and analyzed from five British Columbia rivers in the summer of 1979: Skeena, Columbia, Sumas, Similkameen and Okanagan Rivers, all of which (except the Skeena) cross the Canada - United States boundary. The source of indicator bacteria is determined by differentiating between animal and human sources, and evaluating the characteristics of the watershed near each sampling station. The three major sources of bacterial input to the rivers, namely, land surface, channels of rivers or streams, and direct inputs, are described. Two methods of analysis were used for fecal coliform determination, the membrane filter technique and the most probable number technique using the multiple tube fermentation test. Data were summarized by using the arithmetic mean. Results indicate that fecal coliform concentrations in all the rivers were lower than the suggested criteria for irrigation and non-contact recreation, 1000/100 ml. No relevant use of these rivers is seen to be restricted by sanitary water quality and all rivers sampled exceeded Canadian drinking water standards.

062913
FLETCHER WK, HOLMES GS, LEWIS AG * **Geochemistry and biological availability of iron and trace elements in the upper Fraser River estuary** * Mar Chem * 12(2,3) 195-217 * 1983-03.

Water samples were collected hourly at three depths from two twenty-five hour stations in the Fraser River estuary. Sampling stations were selected to represent both minimal saline intrusion and prominent salt wedge environments. A bioassay using the diatom Thalassiosira pseudonana was run to evaluate biological availability of the dissolved metals. Inter-element ratios indicate that changes in bulk composition of suspended particulates occur throughout the tidal cycle as a result of resuspension and mixing of particulates from different sources. However, Fe:Ti ratios and leachable Fe indicate loss of about 1wt.% Fe from river-borne particulates mixing with saline waters. This loss from particulates is accompanied by a corresponding increase of "dissolved" Fe concentrations, from 10ppb in both fresh waters and the salt water intrusion, to more than 80 ppb in mixed waters of intermediate salinity. Co, Cu, Mn and Pb show similar trends to Fe which are attributed to their association with "dissolved" Fe colloids. This is consistent with bioassay data which suggests that the biological availability of metals changes abruptly with the change in dissolved Fe concentrations.

066558
FLETT RJ * **Chemical, microbiological and physical interactions of acidic precipitation within a lake and its drainage basin** * APIOS Rep No 004/81 * 46p * Ont Minist Environ * 1981-07.

This paper describes the major chemical interactions between rainfall, a watershed and its included lake. Attention is focused on the reactions of carbon, nitrogen and sulfur because of key roles they play in chemical and biological processess that determine the pH of soils and lake waters. Lake acidification is considered to be the greatest environmental problem in Canada. Hence, Provincial and Federal grants have been provided to better understand the mechanism of lake acidification. Many of the thousands of lakes in the Canadian Shield are sitting on sparingly soluble granitic bedrock. The pH of these lakes are throught to be dropping rapidly and acid precipitation, of uncertain

origin appears to be the cause. Many of these lakes are surrounded by summer cottages which were located there because of the clean water and good fishing. This paper is an effort to determine the actual cause of the acid precipitation.

065860
FORTIN M, BACCHUS A, POST L * **Impact of Stratford City impoundments on water quality in the Avon River.** * Stratford/Avon River Environ Manage Proj Tech Rep S-1 * 26p * Ont Minist Environ, 985 Adelaide St South, London, Ont N6E 1V3 * 1983-04.

As part of the Stratford-Avon River Environmental Management Project, the Southwestern Regional Office of the Ontario Ministry of the Environment collected data on water chemistry and sediments at 13 stations along the Avon River during 1980 and 1981. In addition, the River Systems Unit of the Water Resources Branch, MOE, conducted an intensive in-lake survey of Lake Victoria in August 1980. Data from these surveys and other sources were used to assess the impact of Lake Victoria and the John Street weir impoundment on the water quality of the Avon River. The analysis focussed on summer impacts (May to September) since this is the period of greatest concern in the study and since the impoundments have in the past been drawn down over the winter period. Major influences of the impoundments include increases in BOD5 and reductions in dissolved oxygen (O) concentrations, increases in total phosphorus and TKN, decreases of soluble phosphorus, increases in suspended solids, increases in zinc concentrations and a reduction of fecal coliform and fecal streptococci bacteria. Some of the processes that may underlie these influences are phytoplankton production, weir de-aeration, contamination from storm-sewer flows and assimilation or decay. An analysis of sedimentation rates revealed that Lake Victoria is very likely an efficient trap for suspended mineral sediments. The observed increase in suspended sediments in flows leaving the lake may therefore be caused by organic debris originating in the lake. From an analysis of bottom sediments, it was found that Lake Victoria sediments display some heavy metal contamination likely related to urban runoff.

063596
FOX ME, CAREY JH, OLIVER BG * **Compartmental distribution of organochlorine contaminants in the Niagara River and the western basin of Lake Ontario** * J Great Lakes Res * 9(2) 287-294 * 1983.

Ten chlorobenzenes, hexachlorobutadiene, and PCBs were measured in Niagara River water and suspended solids, and in western Lake Ontario sediments and benthic fauna. High levels of these contaminants were found on all fractions of the river suspended solids, but the larger particles contained much higher concentrations than the smaller particles. A portion of the CBs, HCBD, and PCBs present in the lake sediments was available to benthic organisms. A trend toward greater bioaccumulation for compounds having higher octanol-water partition coefficients was observed at all trophic levels.

063999
FRASER AS, ROBERTSON A * **Materials balance**, IN: IFYGL - The International Field Year for the Great Lakes * AUBERT EJ, RICHARDS TL * 341-352 * Natl Oceanic Atmos Adm, Great Lakes Environ Res Lab, US Dep Commer, Ann Arbor, MI 48104 US * 1981-03.

This chapter describes studies undertaken as part of the Biology-Chemistry Program of the International Field Year for the Great Lakes, to determine the form and amount of materials entering, leaving, and residing in Lake Ontario and to measure the quantities of nutrients and toxic chemicals flowing into and out of the lake. These studies identified significant loadings to the lake, computed discharge rates, established the change in storage, determined the whole lake content and the change in lake storage and also defined more clearly the relationship between the loadings, the discharge, the storage in the lake, and the storage in the sediments. Canadian and United States data collection cruises to obtain whole-lake balance, are described. A brief discussion of a special study to examine the carbon system of Lake Ontario to identify the sources and sinks of the various forms of carbon in the system, is also included.

062425
FREEMAN NG, ROFF JC, PETT RJ * **Physical, chemical, and biological features of river plumes under an ice cover in James and Hudson Bays**, IN: James and Hudson Bay Symp, Scientific Studies on Hudson and James Bay, II, Guelph, Ont, April 28-30, 1981 * MARTINI IP * Nat Can * En * ISSN 0028-0798 * 1982-12 109.

Observations of salinity, temperature, currents, nutrients and seston taken in February and March 1980 from the close-packed to solid ice cover off the La Grande River mouth provide a fairly detailed description of the flow and mixing of the river plume with the more saline basin water and the resulting effect on bio-chemical distributions. Within the first 5-10 km off the river mouth, a large horizontal divergence of the river flow, accompanied by a substantial reduction in average flow velocities in the plume, is observed. A significant thinning of the interface occurs in this region due to internal hydraulic control, but there is no apparent increase in entrainment of salt water into the plume. For the next 25-30 km the interfacial Froude number is negative and the

upper layer continues to thin out, indicating that surface water, with an estimated residence time of only 12 days, is being mixed downward due to increasing tidal action just under the plume. A front-like feature, delineated by maximum horizontal gradients in density, separates this region from the well-mixed area beyond. In this latter region, shoaling bathymetry increases the tidal currents and vertical mixing of the water column seems to take place. The biochemical distributions support the view of an earlier study that the La Grande River provides minimal nutrient contributions to James Bay in the winter. Nutrient values tend to be low within the plume and high within the basin, while the opposite is true of seston levels, thus suggesting marine and riverine sources, respectively. Under-ice concentrations of dissolved labile nutrients are largest in the well-mixed region seaward of the stabilizing surface plume and an ice flora community is well established in this area by the end of February. Levels of NO3 + NO2 in the surface ice and in the snow cover are generally a factor of two or three greater than those in the water immediately below the ice, indicating that melting ice and snow cover may be an important nutrient source to James and Hudson Bays during the spring phytoplankton bloom. A comparison of the above physical data with salinity and current data collected off La Grande under the lower discharge conditions of 1976 and off Great Whale River (1979) where both discharge and background tidal conditions were substantially less, shows that the volume of freshwater in the plume is directly related to river discharge and inversely related to tidal kinetic energy in the basin. A correlation of estuarine Richardson number with top-to-bottom salinity difference also shows two distinct mixing regions: for Ri sub E is greater than 1.0 a stable region exists where mixing has a minus one sixth power dependence on estuarine Richardson number and for Ri sub E is less than 1.0 a well-mixed region, which has the typical minus three-quarters power dependence. In the initial region just off the river mouth, no significant entrainment or mixing into the plume is observed and thus no correlation of plume salinity with densimetric Froude number is obtained.

F11958
GALAND JL, BRIERE F, ROUSSELLE J, BERON P * **Relation qualite-debit dans un reseau unitaire** , IN: Compte rendu, Colloque sur la modelisation des eaux pluviales, tenu au Holiday Inn Centre-Ville, Montreal, Que, 8-9 sept, 1983 * BERON P, BARNWELL T * Rapp GREMU 83/03 * 75-95 * Ec Polytechnique Montreal & US Environ Prot Agency * 1983-10.

Cette presentation fait etat de l'etude de 27 debits d'orage echantillonnes a l'ete 1981 sur le territoire de la Communaute urbaine de Montreal. Aussi bien les debits que la qualite des eaux usees ont ete echantillonnes. Les techniques de ce groupement sont utilisees afin de definir des sous-groupes de pluies grace auxquels les auteurs ont etudie des relations qualite-debit.

062738
GARDNER WS, NALEPA TF, SLAVENS DR, LAIRD GA * **Patterns and rates of nitrogen release by benthic Chironomidae and Oligochaeta** * Can J Fish Aquat Sci * 40(3) 259-266 * 1983-03.

Metabolic mineralization of ammonium by tubificid worms and chironomid larvae appears to be an important mechanism contributing to nitrogen regeneration from aerobic lake sediments. Although mean rates of nitrogen release were similar for the two groups of benthic invertebrates, the patterns of release were different. Tubificids released nitrogen (ammonium plus primary amines) continuously, whereas chironomids released it in spurts several times per hour. Mean ammonium-release rates were generally constant with time after the animals were removed from food for both species. This implies that ammonium regeneration for these benthic animals is primarily an endogenous process. Conversely, primary amine nitrogen release often decreased with time after food removal and may reflect either egestion of partially digested materials from the animals' guts or a decrease in the metabolic pool size of free amino acids.

062536
GARRETT CL * **Fraser River estuary study, Water quality, Toxic organic contaminants** * 125p * Gov Can and BC Gov * 1980-03.

This report is a compilation of available data pertaining to the contamination of the Fraser River and its estuary by toxic organic contaminants. The main objectives were to: document localized areas of the high contamination; identify known and potential sources of release to the environment; and make recommendations with regard to the need for further investigation. Existing data relating to use patterns, sources of release and environmental levels of these compounds in the Fraser River system are confined primarily to PCBs and the organochlorine pesticides. Much of this information was collected in the early 1970's and information on current levels of contamination is limited. Levels of organochlorine pesticides are generally low and are thought to reflect background concentrations. It is apparent, however, that industrial and sewage treatment plant discharges into the Fraser River system have contributed to localized elevated PCB levels in sediments and biota. Despite recent restrictions on industrial uses of these compounds, certain facilities continue to discharge significant quantities. Limited monitoring within the past two years has also indicated the presence of such compounds as

chlorinated phenols, phthalate esters, hexachlorobenzene and polycyclic aromatic hydrocarbons in the effluents and/or receiving environments of certain industrial and sewage treatment facilites.

066376
GEARING JN, GEARING PJ * **Suspended load and solubility affect sedimentation of petroleum hydrocarbons in controlled estuarine ecosystems** . IN: Conf on Pollution in the North Atlantic Ocean, Halifax, NS, Oct 19-23, 1981 * Can J Fish Aquat Sci * 40(suppl 2) 54-62 * 1983.

The concentrations of No. 2 fuel oil and a suite of hydrocarbons with varying chemical properties (perhydrofluorene, pristane, biphenyl, 1-methylnaphthalene, 9-methylanthracene, and pyrene) were measured over time in the water column, on suspended particles, and in the sediments of two controlled microcosms receiving different amounts of mixing energy. The initial aqueous concentrations of the No. 2 fuel oil and other hydrocarbons were 330-500 micro g/L and 0.80-10.8 micro g/L, respectively. The levels of suspended particles were 3-5 mg/L in the control microcosm and up to 160 mg/L in the highly mixed system. The simulated storm made no major difference in the overall fate of the hydrocarbons. The concentration on particles collected in sediment traps was considerably lower in the tank with high suspended loads, and roughly equal amounts of hydrocarbons were eventually measured in the sediments of each microcosm.

062873
GHEBRE-EGZIABHIER K, ST ARNAUD RJ * **Carbonate mineralogy of lake sediments and surrounding soils 1. Blackstrap Lake** * Can J Soil Sci * 63(2) 245-257 * 1983-05.

The carbonate mineralogy of the Blackstrap Lake sediments in central Saskatchewan indicates that the lake deposits are composed of carbonatic minerals similar to those found in surrounding soils and glacial deposits. Textural differences reflect the transport of finer materials (silts and clay) from the adjacent eroding landscapes. In particular the persistence of dolomite in the silt fractions of the lake sediment is a good indication that part of the calcite together with the dolomite are derived from surrounding soils. The sediment sand fraction contains appreciable Mg-bearing calcite and mollusk shells of pure calcite. Changes in the ionic concentrations of the lake water indicate that dissolution-precipitation processes have affected sediment composition. The increased calcium carbonate equivalent percentages and the presence of secondary magnesium-bearing calcites in the lake sediments suggest that this is so, particularly since erosional processes could not account entirely for the differences observed between the sediments and surrounding soils. The presence of gypsum and the nature of the secondary calcites tie in well with the known historical background of the Reservoir. The increased ionic concentration of the lake water over the last 15 yr or so since the original inception of the Reservoir is attributed to the influx of drainage waters, evaporation and possibly the effects of groundwater entry from below.

062852
GLASGOW WM * **Fisheries and wildlife resources and the agricultural land base in Alberta** (see chapter 8 for complete reference - voir chapitre 8 pour la reference complete)

F11917
GOBEIL C, COSSA D, PIUZE J * **Distribution des concentrations en mercure dans les eaux de l'estuaire moyen du Saint-Laurent** * Rapp tech can hydrogr sci ocean no 17 * 17p * Minist Peches oceans, Centre Champlain sci mer, Sci et leves oceaniques, BP 15500, 901 Cap Diamant, Que * 1983-03.

Les variations spatiales et tidales des concentrations en mercure dissous et total dans les eaux du chenal nord de l'estuaire moyen du Saint-Laurent ont ete etudiees pendant la periode du 12 au 16 juin 1980. Les teneurs en mercure total mesurees varient entre 4 et 74 ng par L. Les teneurs en mercure dissous ne depassent jamais 6 ng par L et plus de 50% d'entre elles sont inferieures ou egales a la limite de detection de la methode analytique (3 ng par L). Du a l'abondance des particules en suspension dans la zone de turbidite maximale de l'Estuaire, les concentrations en mercure total y sont plus elevees que celles mesurees tant plus en amont, dans les eaux fluviales, que plus en aval, dans les eaux marines qui proviennent de l'Estuaire maritime. Dans ces parties extremes de notre region d'etude, les teneurs totales en mercure sont generalement inferieures a 8 ng par L.

F11732
GORDON G, KEIFER W * **Un equilibre precaire, fascicule modulaire de la chimie de l'energie et de l'environnement** * 144p * Ed Etudes vivantes, Montreal, Que * 1981.

Ce document se veut un outil pedagogique d'initiation a la chimie de l'energie et de l'environnement. Les themes abordes dans ce volume sont: la notion d'equilibre dans l'environnement, l'eau, les substances toxiques, l'atmosphere, l'energie: ses utilisations et ses abus, les energies nouvelles. Abondamment illustree, ce fascicule contient egalement des questions sur la matiere acquise.

F11851
GOULET M, LALIBERTE D * **Metaux: contamination du milieu aquatique au Quebec meridional** * Q.E.-51 * 105p * Minist Environ, Dir gen invent et rech, Serv qual eaux, Que * 1982-12.

Ce document etablit un premier portrait de la contamination du milieu aquatique quebecois par sept metaux: le cadmium, le chrome, le cuivre, le mercure, le nickel, le plomb, le zinc, et un metalloide, l'arsenic. Des echantillons d'eau, de sediments, de plantes aquatiques, de mollusques (pelecypodes) et de poissons (benthivores et piscivores) ont ete recueillis a l'ete 1978 pour le programme "Reseau de surveillance des substances toxiques dans le milieu aquatique quebecois". Cinquante-cinq stations ont ete echantillonnees, elles sont reparties dans onze bassins de rivieres parmi les plus polluees du sud du Quebec et se deversant dans la fleuve Saint-Laurent. Les conclusions sont presentees par parametre. Les contaminations sont degagees a partir des fortes valeurs enregistrees simultanement dans les differentes composantes environnementales et les endroits contamines de facon evidente ou probable sont pointes. Une synthese finale des sites les plus contamines par l'ensemble des parametres est ensuite tiree.

F11849
GOULET M, LALIBERTE D * **BPC: Contamination du milieu aquatique au Quebec meridional** * Q.E.-53 * 46p * Minist Environ, Dir gen invent et rech, Que * 1982-12.

Le document etablit un premier portrait de la contamination du milieu aquatique quebecois par les biphenyles polychlores (BPC) Des echantillons de mollusques (pelecypodes) et de poissons (benthivores et piscivores) ont ete recueillis a l'ete 1978, pour le programme "Reseau de surveillance des substances toxiques dans le milieu aquatique quebecois". Cinquante-cinq stations ont ete echantillonnees; elles sont reparties dans onze bassins de rivieres parmi les plus polluees du sud du Quebec et se deversant dans le fleuve Saint-Laurent. La contamination est degagee a partir des fortes valeurs enregistrees simultanement dans les differentes composantes environnementales et les endroits contamines de facon evidente, apparente, discrete ou faible sont indiques. Une carte presente le portrait general de la contamination.

F11622
GOULET M, POTVIN P, PRIMEAU S * **Toxiques inorganiques dans l'eau des rivieres et des lacs du Quebec meridional** * Rapp Q.E.-52 * 294p * Minist de l'environ du Que * 1982-11.

Le document decrit le degre de contamination de l'eau des rivieres et des lacs du Quebec meridional, par dix substances toxiques inorganiques. L'etude repose sur plus de 17600 donnees en rivieres et plus de 5500 en lacs. Ces donnees ont ete recueillies entre avril 1978 et septembre 1980. Les conclusions sont tirees par parametre. Un resume des resultats est d'abord presente suivi du traitement des valeurs individuelles des echantillons recueillis en insistant sur les valeurs elevees, pour finir sur un portrait spatio-temporel des donnees. Une synthese fait ressortir les endroits du Quebec meridional les plus contamines et resume les depassements de criteres de qualite des parametres.

O66571
GOWDA TPH * **Modelling nitrification effects on the dissolved oxygen regime of the Speed River** * Water Res * 17(12) 1917-1927 * 1983.

Field studies on nitrification in an 11 km stretch of the Speed River below Guelph are described. The data, collected during three intensive surveys in spring-summer 1976 and winter 1977, were used to calibrate and verify a steady-state dissolved oxygen (DO) model which incorporates the effects of carbonaceous and nitrogenous oxygen demand (CBOD and NOD), plant and algal respiration and photosynthesis, and reaeration. The model calibration result for one of the survey conditions includes comparisons between the corresponding observed and predicted values of CBOD, NOD and daily minimum and maximum DO. The comparisons of the first three sets of parameters were satisfactory, but the predicted maximum DO values were generally higher than the observations. The model verification results for the two other survey conditions were somewhat similar to those of the calibration study. Predictions of the relative effects of various sinks on the minimum DO levels under one of the survey conditions indicate that instream nitrification alone causes a DO deficit of about 4.5 mg per l; in contrast, the deficits due to CBOD and respiration were in the order of 1 mg per l only. The model was also used to predict spatial DO distributions under several streamflow and temperature regimes. For each case, computer runs were made with NOD concentrations resulting from a conventional secondary (i.e. non-nitrified) effluent and a nitrified effluent. The predictions indicate that the minimum DO level increases with an increase in streamflow and a decrease in temperature. In the case of non-nitrified effluents, anoxic conditions are predicted to occur at about 25C when streamflow rates are lower than about 1 cu m per s; whereas in-plant nitrification would result in daily minimum DO levels of 4 mg per l or greater. The predictions also show the occurrence of two DO sags in the study stretch, one being mainly due to a high degree of nitrification, while the other is due to the combined effect of all of the DO sinks.

062099
GOWDA TPH * **Water quality prediction in shore-attached mixing zones in rivers, An assessment procedure prepared for: Working Group II of the Water Management Steering Committee** * 59p * Ont Minist Environ, Water Resour Branch, Qual Prot Sect, Toronto, Ont * 1981-08.

This report deals with descriptions of field survey and prediction procedures applicable to mixing zones below bank outfalls in shallow rivers. The mathematical model formulations, based on the stream tube concept, are applicable to a natural stream stretch in which the discharge remains constant. The model is developed from an analytical solution of the steady state, 2-D convection-diffusion equation, modified to account for the longitudinal variabilities of decay and dispersion parameters. Procedures for carrying out field studies, data analysis and parameter estimation are presented. A step-by-step design procedure, based on the critical point method, is outlined to compute critical concentration and allowable effluent concentration of a pollutant, as well as the longitudinal boundary of a LUZ. An example illustrates the application of the design procedure. The application of the model to assess the impact of typical management options on allowable effluent concentrations of total ammonia and associated maximum longitudinal spreads is also illustrated. The results indicate that, in general, the allowable effluent concentration as well as the maximum longitudinal spread of LUZ would increase due to: (a) an increase in the lateral boundary of the LUZ; (b) an increase in the streamflow rate; and (c) a decrease in temperature. Data on the distribution of residual chlorine in the Boyne River below Alliston were used to validate the model satisfactorily for a nonconservative material.

067073
GOWDA TPH, POST LE * **Mixing zone studies in the Grand River basin** . IN: Can Soc Civ Eng 1983 Annual Conf, Proc, Recent Advances in Municipal and Environmental Engineering, June 1-3, 1983, Ottawa, Ont * 121-140 * Can Soc Civ Eng, Munic Environ Div * (1983).

This paper presents the development and application of a steady state mathematical model based on the "stream tube" concept to assess the impact of various management options on mixing zones of rivers in the Grand River Basin. The processes simulated in the model include advection, transverse dispersion, and first-order decay of pollutants, as well as the chemical equilibrium of ammonia. In previous studies, the model was calibrated and verified satisfactorily using chloride ion distribution data collected in the Grand River and total residual chlorine data from another river. The model was used as part of the Grand River Basin Water Management Study to evaluate the impact of various options on the mixing zone boundaries for un-ionized (toxic) ammonia and total residual chlorine at the Grand River below Waterloo, Kitchener and Galt, and the Speed River below Guelph. The options evaluated include various river flows and effluent flows projected for the planning period 1981-2031. The predictions indicate that a zone of passage equal to 60% of river flow is attainable for chlorine in all cases except in the Speed River below Guelph beyond the year 2001, and in-plant nitrification is required at Waterloo and Kitchener under the present conditions in order to comply with the objective of un-ionized ammonia. With in-plant nitrification at Guelph, the ammonia objective is not complied in 1979 for summer conditions and by 2001 for winter conditions. For Galt, the ammonia objective is met with conventional secondary treatment under all options. The maximum longitudinal boundary of limited use zone for various options is also summarized.

065176
GRAHAM A, KNIGHT G * **Stripcropping demonstration project** * Stratford/Avon River Environ Manage Proj, Tech Rep R-10 * 11p * 1982-09.

The Stratford/Avon Project was involved in a major stripcropping project undertaken by a landowner located in the upper part of the Avon River basin in the Demonstration Sub-Watershed during 1981-1982. The purpose of the project is to demonstrate the effectiveness of stripcropping in relation to the overall goals of the Rural Sub-Committee of reducing non-point sources pollution through runoff and erosion control. Alternate strips of an alfalfa forage mixture were introduced into a field which had grown continuous corn for several years previous. The farmer is convinced that the stripcropping, in combination with other conservation measures, will assist greatly in controlling sheet and rill erosion while maintaining the long-term productivity of the soil.

065175
GRAHAM A, KNIGHT G * **Demonstration of improved livestock and manure management techniques in a swine operation** * Stratford Avon River Environ Manage Proj, Tech Rep R-3 * 14p * 1982-09.

Staff associated with the Stratford/Avon River Environmental Management Project worked with a private landowner in mitigating two very common sources of water quality impairment associated with livestock operations throughout the Avon River Basin. One project dealt with restricting livestock access to a watercourse through fencing and a culvert installation. Details of this project are contained in Technical Report R-7. The second demonstration was aimed at preventing manure-contaminated runoff from entering the

same nearby watercourse. This was accomplished by the construction of a concrete retention wall and accompanying system which pumped the runoff into a liquid manure tank where it could be stored for use in land application. The purpose of the project was to demonstrate that nutrient and sedimentation problems often associated with livestock enterprises can be controlled successfully by commonly applied management and conservation practices. Landowner approval and local reaction have been very favourable since completion of the work in the summer of 1981.

065174
GRAHAM A, KNIGHT G * **Grassed waterway demonstration projects** * Stratford/Avon River Environ Manage Proj, Tech Rep R-7 * 35p * 1982-09.

A series of four grassed waterways were constructed in the upper part of the Avon River Basin during 1981. The purpose of the projects is to demonstrate the cost-effectiveness of grassed waterways in relation to the overall goals of the Rural Sub-Committee of reducing non-point source pollution through runoff and erosion control. Average costs of construction varied from $1.00 - $3.00 per foot depending on length of run, size of drain tile, placement of catch basin, and outlet structure. Recommended varieties of grasses and legumes have stabilized the waterways. The installation of drop inlets, tile drainage and the construction of protected outlets have further controlled erosion. Landowner acceptance and local reaction has proven favourable to project implementation. Additional monitoring of these projects will further establish their effectiveness in reducing sediment and phosphorus loadings to downstream areas.

065847
GRAHAM A, KNIGHT G * **The controlled access of livestock to open watercourses** * Stratford/Avon River Environ Manage Proj Tech Rep R-8 * 18p * 1982-11.

Staff associated with the Stratford/Avon River Environmental Management Project worked with three farming landowners in the Upper Avon Basin to demonstrate cost-effective means of controlling or restricting livestock from open watercourses. This technical report deals with the identification of each problem situation and recommendations to be considered in the design of the remedial measure. Two projects demonstrated controlled access of livestock to an open drain; the third project involved restricting livestock from the drain altogether. Various crossing designs and fencing alternatives were used in the projects. The landowners concerned, proved to be receptive to the approaches used to control or prevent access of livestock to open watercourses. Further monitoring of these demonstrations will give better indication of their effectiveness in reducing sediment and nutrient loadings to downstream areas.

065849
GRAHAM A, KNIGHT G * **Sediment basin demonstration project** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

065505
GRAVELAND DN * **Irrigation water quality study of Etzikom Coulee** (see chapter 8 for complete reference - voir chapitre 8 pour la reference complete)

066850
GREAT LAKES WATER QUAL BOARD * **1983 Report on Great Lakes water quality** * 97p * Int Jt Comm, Great Lakes Reg Off, 100 Ouellette Ave, Windsor, Ont N9A 6T3 * 1983-11.

This report, the tenth prepared by the Great Lakes Water Quality Board to the International Joint Commission under the Great Lakes Water Quality Agreements of 1972 and 1978, focuses on eutrophication and toxic chemicals as the two major system-wide environmental quality problems of the lakes. In addition, the Board reports the changes resulting from remedial measures in 18 Class "A" areas of concern (designated on the basis of a serious degradation of water quality causing impairment of water uses in a specific locale), identified by the Board in 1981. Also, the Board provides further updated information on point and nonpoint sources of pollution to the lakes. It reviews the performance of the parties concerned in attempting to meet the December 31, 1982, deadline when all municipal pollution abatement facilities were required to be in place and in operation, and brings to the Commission's attention some further factors regarding municipal pollution abatement. The Board reviews the status of program development and implementation of nonpoint source control programs of Great Lakes jurisdictions. The report also includes a description of other activities being carried out by the Board, its Committees and Work Group with respect to Great Lakes Water Quality Agreement issues such as surveillance and monitoring, data quality assurance, dredging, radioactivity, and vessel waste discharges.

F11780
GREEN D * **Le Quebec et le bassin des Grands Lacs/fleuve Saint-Laurent** * L'environnement * 9(03-04) 39-41 * 1982-11.

L'auteur tente d'etablir un rapprochement entre le systeme écologique des Grands Lacs et celui du fleuve Saint-Laurent, en ce qui touche principalement la contamination des eaux de l'ensemble du bassin du Saint-Laurent

versus celui des Grands Lacs. Il signale l'importance de la pollution des eaux d'Etats outre-frontieres en particulier les Etats industriels americains et la province de l'Ontario, et rappelle a cet effet la presence de Mirex chez les anguilles du fleuve et de la dioxine chez d'autres especes de poissons, ainsi que les ecoulements chimiques des anciens sites de dechets toxiques situes pres de la riviere Nicaragua (N.Y.) et dont les effets se font sentir dans le fleuve Saint-Laurent.

066097
GRIDLEY NC, LIN KC * **Modelling dissolved oxygen in a proposed reservoir** . IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * v2 581-601 * Can Soc Civ Eng * (1981).

A one-dimensional finite-difference model is developed to predict dissolved oxygen (DO) concentrations during summer thermal stratification for the proposed Green River Reservoir in northwestern New Brunswick. Initial DO concentrations, surface reaeration, bio-mass activity, sediment demand, site preparation, and vertical dispersion are considered. Using extensive field data from Third Green Lake near the proposed dam site, the model is satisfactorily tested. Predicted DO concentrations for the proposed reservoir are developed under a wide range of conditions. For possible worst conditions it is found that 48% of the hypolimnion would exhibit DO concentrations below 5 mg.l-1. Sensitivity analyses demonstrate that DO concentrations in the depilimnion and thermocline are affected primarily by phytoplankton activity and light intensity. Water temperature, initial DO conditions, zooplankton and sediment oxygen consumption, and degree of site preparation affect DO concentrations at all depths.

F11980
GROUPE TECH DE TRAV FED-PROV SUR LA QUALITE DE L'EAU DE LA RIVIERE DES OUTAOUAIS * **Rapport du groupe technique de travail federal-provincial sur la qualite de l'eau de la riviere des Outaouais** * 35p * Environ Can, Minist Environ de l'Ont, Minist Environ du Que * 1981-10.

Le groupe technique de travail federal-provincial sur la qualite de l'eau de la riviere des Outaouais a etudie l'incidence des sels nutritifs, des polluants et de la bacteriologie sur la qualite de l'eau de la riviere. Bien que l'on n'ait decele aucun probleme majeur, on a constate une deterioration de la qualite de l'eau dans certains secteurs. Entre 1972 et 1976, les concentrations de phosphore ont diminue de facon importante grace, en grande partie, a la limitation du phosphate dans les detergents et a la dephosphorisation effectuee dans les usines ontariennes d'epuration des eaux d'egout. Les concentrations d'azote varient grandement tout au long de la riviere, mais aucune tendance generale par rapport au temps n'a pu etre observee. Les concentrations d'oxygene dissous sont generalement acceptables. Mis a part le mercure, les donnees plutot eparses sur les metaux a l'etat de trace et les matieres organiques n'ont revele aucun probleme grave. Il y a contamination bacteriologique dans la region d'Ottawa en raison de la pollution municipal et des autres activites urbaines. Bien que la riviere des Outaouais ait un effet tampon plutot bas et qu'elle soit ainsi exposee a la degradat'on par la pluie acide, les donnees existantes n'indiquent aucune deterioration appreciable.

F11978
GROUPE TECH TRAV FED-PROV SUR LA QUALITE DE L'EAU DE LA RIVIERE DES OUTAOUAIS * **Rapport du groupe d'etude des sels nutritifs** * 108p * Environ Can, Minist Environ de l'Ont, Minist Environ du Que * 1980-05.

Le transport de cinq sels nutritifs, exprime en kg/j, a ete determine a certains endroits, dans la riviere des Outaouais et certains de ses affluents pour lesquels le MDE disposait de donnees. De l'analyse des donnees, il ressort que pour 1971 a 1976, il etait possible d'etudier les parametres suivants: phosphore total, azote Kjeldahl total, orthophosphates filtres, nitrates et nitrites filtres. Les donnees et le calcul figurent aux tableaux 1 a 4 de l'annexe C. Dans les rivieres Bonnechere, Rideau, South Nation, Coulonge, Rouge et du Nord ainsi que dans le ruisseau Green, la teneur en certains sels nutritifs a ete plus elevee que dans la riviere des Outaouais. Des recommandations sont donnees.

F11977
GROUPE TECH TRAV FED-PROV SUR LA QUALITE DE L'EAU DE LA RIVIERE DES OUTAOUAIS * **Rapport du groupe d'etude du plan de surveillance** * 30p * (Environ Can, Minist Environ de l'Ont, Minist Environ du Que) * 1981-09.

Avec son bassin versant de plus de 146 000km carre, dont 63% se trouve au Quebec et 3% en Ontario, la riviere des Outaouais represente le plus gros tributaire du Saint-Laurent. Le sous-groupe d'etude etait charge d'etablir un plan de surveillance continue en vue d'obtenir: une evaluation suivie de l'etat de l'eau dans la partie interprovinciale de la riviere des Outaouais; et des donnees afin de determiner les divers effets que subit ce cours d'eau et d'aider a la gestion de cette ressource. Le present plan a pour but de determiner de facon detaillee, coordonnee et economique les repercussions des activites humaines sur la qualite de l'ecosysteme que represente la riviere des Outaouais. Il decrit l'effort minimum qu'il faudra deployer pour atteindre les objectifs suivants: determiner la qualite actuelle de l'eau,

identifier les zones problemes, aider les gestionnaires a elaborer et a mettre en oeuvre des correctifs, et determiner les tendances de la qualite de l'eau. L'Ontario et le Quebec possedent un modele pour estimer les apports de sources diffuses. On recommande d'evaluer ces deux modeles et d'en choisir un pour l'etude.

F11979
GROUPE TECH TRAV FED-PROV SUR LA QUALITE DE L'EAU DE LA RIVIERE DES OUTAOUAIS * **Rapport du groupe d'etude des contaminants** * 24p * Environ Can, Minist Environ de l'Ont, Minist Environ du Que * 1980-04.

L'examen des donnees disponibles relatives aux contaminants de l'ecosysteme de l'Outaouais a revele l'existence d'un certain nombre de problemes de contamination localises, bien que la riviere n'ait donne dans son ensemble aucun signe de contamination exceptionnel par aucune des substances etudiees jusqu'a present, a savoir: metaux a l'etat de traces; BPC et contaminants organiques; pluies acides, radionucleides; et, autres. Ce rapport a pour objectif global de faire le point des connaissances actuelles relatives a la qualite des eaux de la riviere des Outaouais. Le mandat particulier du groupe d'etude sur les contaminants est: d'examiner les donnees du passe; d'effectuer l'analyse et l'interpretation des donnees; de mettre en lumiere les problemes lies aux contaminants; et, de deceler les lacunes dans le corps des donnees (ainsi que les cas de chevauchement).

061819
GUMMER WD * **Pesticide issues and environmental concerns** * 30p * 1982-02.

Environmental pesticide concerns of the present and in the 80's with respect to water and environment in general, are investigated. Growing public awareness of and concern for environmental quality, increased attack on pesticides from pressure groups including the public, churches and environmentalists, and the stand taken by pesticides advocates, notably the chemical manufacturers, are discussed. The commercial life stages of a pesticide, highlighting controversial issues and environmental concerns, are described. These include: 1) need - use of pesticides to increase food productivity and standard of living and the need to strike a balance between pesticide need and environmental debt; 2) research and development - rigid screening procedures, need to find additional alternatives for chemical pest control, and concerns in the toxicity area; 3) market application - misuse of labelling instructions in pesticide application practices; and 4) waste disposal - how surplus pesticides are disposed of. The environmental disposition of pesticide residues, including sources, factors controlling mobility (physical/chemical properties, time of application, stability/volatility), and effects on pesticide mobility by wind/drift/precipitation, runoff, leaching, river hydrology, and the biology of water systems (pathways and food chain), is examined.

063227
HADJINICOLAOU J, SPRAGGS LD * **Methodology for assessing toxicity avoidance** . IN: Proc 8th Annu Aquatic Toxicity Workshop, 2-4 Nov 1981, Guelph, Ont * Can Tech Rep Fish Aquat Sci 1151 * 68-82 * 1983-03.

The design and implementation of a channel designed to perform dynamic avoidance testing of industrial effluents is discussed. An existing 9 m long hydraulics channel has been modified and appropriate holding tanks added to give an innovative new experimental tool in assessing the environmental impact of industrial effluents. The objective of the present paper is to discuss the experimental equipment and the methodology used in the experiments. The rationale used in designing the methodology will be presented. The method of data acquisition and subsequent analysis will be discussed to give a general appreciation of the techniques being used to determine the avoidance. Preliminary results from testing the apparatus will be presented for subsequent discussion in conjunction with the rationale used in developing the new techniques described in the paper.

066930
HALAPPA GOWDA TP * **Critical point method for mixing zones in rivers** * J Environ Eng * 110(1) 244-262 * 1984-02.

Expressions for the coordinates of a critical point, occurring along a given lateral boundary of a limited use zone within a mixing zone below a bank outfall in a river channel, are developed. A family of curves is developed for a range of dimensionless coordinates of the critical point. An expression for allowable effluent concentration of a pollutant is obtained in terms of critical concentration and water quality criterion. A graphical procedure for determining the longitudinal boundary of a limited use zone is described. The predictions of the critical point method are validated using total residual chlorine distribution data from a natural stream. The application of the methodology is outlined in a step-by-step design procedure and illustrated by an example for ammonia. In general, the method is applicable to exponentially decaying nonconservative pollutants.

065789
HALAPPA GOWDA TP, DEWEY RJ * **Impact of proposed Glengowan dam flow augmentation of**

Thames River water quality . IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * v2 867-890 * Can Soc Civ Eng * (9183).

The Thames River water management study report, prepared in 1975 by the Ontario Ministries of Natural Resources and Environment, recommended the construction of the Glengowan Dam primarily for flow augmentation to improve the river water quality (Recommendation No. 1). As part of the environmental impact assessment of the proposed dam, detailed water quality prediction studies were carried out using deterministic and stochastic models to evaluate the impact of the proposed flow augmentation and wastewater loading options. The river receives treated wastewater effluents from five water pollution control plants (WPCP) in the study area, all located within the City of London. The processes simulated by the models include advection, decay of carbonaceous and nitrogenous oxygen demand (CBOD and NOD), sediment oxygen demand, atmospheric reaeration, respiration and photosynthetic activity of aquatic macrophyte community. The options modelled include: (a) projected CBOD and NOD oxygen demand loading rates from the five WPCP's for the planning period 1981 - 2001; (b) low flows attainable with augmentation from the existing Fanshawe reservoir and the proposed Glengowan Dam; and (c) zero loadings to the Thames River from WPCP's attainable with effluent bypassing to Lake Erie. The results of the modelling studies are presented in this paper.

066658
HALFON E * **Organic contaminants fate model for the prediction of transient water quality in the Niagara River plume, Lake Ontario** * NWRI Unpublished Manuscr Numbered Ser 83-3 * 36p * Can Cent Inland Waters, Burlington, Ont L7R 4A3 * 1983-03.

A fate model (NIAGARA) of organic contaminants in the Niagara River and in the plume was developed to assess the relative importance of transport, degradation and volatilization processes. The model also predicts concentrations in several compartments, including suspended sediments, water, plankton, fish and bottom sediments. Three contaminants, Mirex, 1,2,3,5-tetrachlorobenzene (TCB) and lindane were modelled. Simulations show that the largest amount of contaminants is usually in the "defined" water fraction, namely the fraction including colloidal matter which passes through a 0.45 micro m filter. Simulations were performed for a 100 day period, 40 days of loading followed by 60 days of no loading. During the 40 days fish concentrations did not reach equilibrium with Mirex and TCB, but they did with lindane. Once loadings were stopped, fish cleared lindane rapidly but not mirex and TCB, as described in the literature. Amphipods have a minute proportion of contaminants in the sediments.

062405
HALFON E * **Uncertainty in modeling the environmental fate of Mirex in Lake Ontario** . IN: General Survey of Systems Methodology, Proc Symp on Systems Methodology, Washington, DC, January 5-9, 1982 * TRONCALE V * 6p * 1982.

Mathematical models are idealizations of the real system under investigation. As such the models are imperfect representations and contain errors that influence their prediction reliability. A simulation model is employed to quantify the behavior of a persistent chemical, Mirex, in the water column and in the sediments of Lake Ontario. Mirex entered the lake from the Niagara and Oswego rivers. Simulations show that Mirex will remain a chronic problem because it can not be biologically degraded. Uncertainty analysis has identified important chemical and environmental characteristics which control Mirex behavior in Lake Ontario. The most important is the bulk density of the sediments followed by the water-sediment exchange processes. Montecarlo simulations are used to simulate errors due to uncertainty in model parameters and to environmental variability.

064414
HALLETT DJ, SHEAR H, WESELOH DV, MINEAU P * **Surveillance of wildlife contaminants on the Great Lakes** . IN: International Association of Theoretical and Applied Limnology, Proceedings, UP, 1980 * SLADECEK V * 21(3) 1734-1740 * E Schweiz Verlagsbuchhandlung, D-7000 Stuttgart 1, DI * 1981.

The monitoring of wildlife contaminants on the Great Lakes is described, including a discussion on the properties of toxic substances considered when designing programs to monitor these substances in aquatic ecosystems. Reasons for the selection of the herring gull (Larus argentatus), the monitor species which represents the top trophic level of the Great Lakes aquatic food chain, are presented. Egg collections from two herring gull colonies, monitored annually from each of the five Great Lakes, provide material for routine residue analysis from which spatial and temporal trends are obtained, state of the art analysis for new, or previously unrecognized contaminants, and biological parameters such as eggshell thickness. Observation of the colony also provides data on reproductive success. It is concluded that the use of biological indicator species has proven to be an effective approach to contaminant monitoring.

062096
HAMDY Y * **Dispersion of effluent plumes from diffusers on near-shore regions of the Great Lakes, Volume I Initial mixing processes, An assessment procedure prepared for Working Group II of the Water Management Steering Committee** * 47p * Ont Minist Environ, Water Resour Branch, Great Lakes Sect * 1981-04.

This paper reviews the buoyant jet theory in deep and shallow receiving waters. Analysis of predictive models and their applicability to submerged diffuser outfall discharges into the coastal zone of the Great Lakes are presented. The review is focused on the predictions of initial dilution factors under stagnant or low current conditions since they provide a worst case minimum dilution that is improved by the presence of moderate-to-strong longshore currents. Simplified methods are summarized and nomograms constructed to estimate initial dilution factors for discharges from different types of diffuser outfalls. Predictions of initial dilution ratios under stagnant conditions based on deep and shallow water models are presented in terms of multiport diffuser design parameters: port spacing, port diameter, and jet velocity. Diffusers designed according to the theory of deep water models are based on a stable near-field which is not prone to horizontal circulation and re-entrainment. The interference of individual jets should be minimized and the discharge Froude number should not exceed 30% of the critical value to ensure that the depth of the internal hydraulic jump is not exceeding one-half of the water depth. The spacing of ports on one side of the diffuser should be at least 2.5 times the water depth. Diffusers based on deep water models to achieve a certain average initial dilution are longer than those based on shallow water models. The criteria for shallow water conditions should be met according to diffuser type provided that jet interaction occurs. The mechanics of diffusers in shallow waters are classified according to the diffuser type.

065506
HAMILTON H * **Pine Lake water quality report, July 1980** * 26p * Alberta Environ, Pollut Control Div, Water Qual Control Branch * 1980-07.

Pine lake is located in central Alberta, approximately twenty-five miles southeast of Red Deer. As a result of its proximity to both Red Deer and Calgary it receives heavy recreational user pressure. The Water Quality Control Branch of Alberta Environment undertook a study of the lake in response to a need, defined in the Pine Lake Management Plan (Red Deer Regional Planning Commission, 1977), to establish baseline water quality conditions for the lake. Results of the two year study are reported here with emphasis on defining the trophic status of the lake (its capacity to produce algae and aquatic plants). A comparison of Pine Lake with other Alberta lakes is also included, as well as prediction of future changes in the lake water quality.

065498
HAMILTON HR * **Lac La Nonne water quality report, November, 1980** * 33p * Alberta Environ, Pollut Control Div, Water Qual Control Branch * 1980.

Lac La Nonne is located in west-central Alberta, 85 kms northwest of Edmonton. Shoreline development of the lake was restricted in August 1977 until such time as a lake management plan could be completed by the Edmonton Regional Planning Commission and the Alberta of Department of Municipal Affairs. As a technical component of the management plan Alberta Environment, Water Quality Control Branch undertook a two year limnological study of the lake, the results of which are reported here. The purposes of the study were to define the current trophic status of Lac La Nonne, and to recommend how best to mitigate man's impact on it.

066811
HART WC, SCOTT RS * **Levels of heavy metals and coliform bacteria in Bridgeport Basin July-October 1979** * 14p * NS Environ Control Counc, Halifax, NS * 1980-02-26.

The purpose of this study was to obtain information regarding the levels of heavy metals and coliform bacteria in shellfish and inlet waters in Bridgeport Basin, Cape Breton, Nova Scotia. Water samples to be analyzed for total and fecal coliforms and heavy metals were collected from 5 streams which flow into Bridgeport Basin. Shellfish samples were collected from 7 sites in the Basin. These samples were ground and analyzed similarly for coliform counts and heavy metal concentrations. Results indicate that the water samples proved unsuitable for human consumption without chlorination and are probably contributing coliform bacteria to shellfish beds in the Basin. Heavy metal concentrations, except for iron and manganese, were all within levels considered suitable for human consumption. Coliforms found in the shellfish tissues were high and depuration would be necessary before being sold commercially. Heavy metal levels in the shellfish tissues were relatively high compared to the recommended maximum daily human intake levels for arsenic, cadmium and lead.

065911
HEIDTKE TM, SCHEFLOW DJ, SONZOGNI WC * **U.S. heavy metal loadings to the Great Lakes: estimates of point and nonpoint contributions** * 33p * Great Lakes Basin Comm * 1980-01.

Estimates of current (mid-1970's) and future loadings of lead, copper, zinc and cadmium within the U.S. portion of the Great

Lakes basin reveal that Lake Erie receives the greatest input of metals from municipal point sources and urban runoff, whereas Lake Michigan receives the largest metals loading from rural land drainage. By the year 1990, municipal inputs to Lakes Erie and Ontario should be approximately 25-30 percent less than mid-1970 levels. Municipal loadings of lead, copper, zinc and cadmium to Lakes Superior, Michigan and Huron are not expected to change significantly over the next 20 years. Although urban runoff control has been previously shown to be an expensive option for reducing total phosphorus loads to the Great Lakes, this particular strategy is likely to achieve the most significant reductions in annual metal inputs. By the year 2000, remedial programs such as frequent street sweeping and measures to reduce runoff can be expected to decrease this component of the load by roughly 40% for each of the metals considered here. This analysis illustrates how systems analysis techniques can be utilized by resource planners and managers to assist them in evaluating alternative water quality management strategies for the Great Lakes.

066596
HICKMAN M, CHARLTON SED, JENKERSON CG * **A longitudinal physico-chemical and algal survey of five rivers flowing through the AOSERP study area** * Alberta Environ, Res Manage Div, Ed Mater OF 28 * 117p * Alberta Oil Sands Environ Res Program * 1980-09.

Longitudinal surveys determining physio-chemical and algae parameters were conducted during 1979 upon the Muskeg, Steepbank, Hangingstone, Ells, and MacKay rivers. Results are presented for each site, and as an average for each river.

064404
HILL G, RAI H * **Microbial response to a uranium mine discharge into the Kern River** , IN: International Association of Theoretical and Applied Limnology, Proceedings, UP, 1980 * SLADECEK V * 21(2) 1111-1114 * E Schweiz Verlagsbuchhandlung, D-7000 Stuttgart 1, DE * 1981.

Effects of uranium mining discharges on the microbiology of the Kern River in California, United States, are described. Samples taken from midstream at five locations, two above and three below the mine effluent, are analyzed. Results indicated: notable increases in the Standard Plate Count, total coliform, fecal coliform, fecal streptococcus, iubrio, pseudomonas and staphylococcus were seen at 1 km and at approximately 8 km downstream of the discharge; bacterial recovery did not occur until about 15 km downstream; decreases in chlorophyll a levels; and, degradation products appeared to decrease as the result of reduced bacterial numbers. Downstream microbiology was found to be significantly different from upstream areas with the difference thought to be a result of uranium mine discharges from the river.

066717
HJ PORTER AND ASSOC LTD * **Municipal landfill: baseline water quality report** * vp * HJ Porter and Assoc Ltd, Halifax, NS * 1982-11.

A survey was undertaken to establish baseline water quality data in the vicinity of the proposed municipal landfill in the Lincolnville area. The purpose of collecting this data was for future reference to ensure that any deterioration of the water is detected. The types of sample stations included domestic wells, streams and stream sediment. On-site monitoring of both bedrock and surficial wells was conducted. The results of studies concerning these stations are contained in the report in full tabular detail.

063491
HOBBIE JE, CORLISS TL, PETERSON BJ * **Seasonal patterns of bacterial abundance in an Arctic lake** * Arct Alp Res * 15(2) 253-259 * 1983-05.

Total bacterial numbers were determined at different times of the year in an arctic lake (0.1 to 3.1 x 10 (sup 6) cells per ml), its inlet and outlet streams (0.4 to 2.9 x 10 (sup 6) cells per ml) and in the nearby Kuparuk River (0.3 to 2.7 x 10 (sup 6) cells per ml). Bacterial counts were made with epifluorescence microscopy and acridine orange staining. The highest numbers of bacteria in Toolik Lake were found in the summer. The distribution with depth was irregular and maximum cell numbers in the water column were found at various depths. Small cells with a volume less than or equal to micro cu m made up the majority of the population in the streams. The peak spring-time bacterial counts observed in the streams and the lake presumably reflected the input of terrestrial bacteria and nutrients in run-off water. Within the lake, the spring peak of bacteria numbers occurred at the same depths that streamwater occurred (as traced with a fluorescent dye). Within a stream, no consistent correlations were found between discharge and bacterial numbers. A comparison of cell numbers between the Kuparuk River and the Toolik Inlet stream revealed a good correlation indicating common controlling factors such as the timing of surface run-off entering the streams. In general, the numbers found are similar to those in temperate lakes and streams.

064557
HODGSON GW * **Biogeochemistry of stream waters: a comparison of the effects of suspended sediments and river-bed biofilms** * Ecol Bull (Stockholm) Vol 35 * HALLBERG R * v35 85-97 *

Stockholm * 1983.

Stream water biogeochemistry is a complex interplay of a number of processes of conversion and transport. Gross parameters of mass transport, heterotrophic potential and depletion factors for in-stream organic substances are useful in an overall sense, but detailed knowledge of the mechanisms of some of the major processes is required. Thus, in the case of microbial uptake and mineralization, it is important to know the relative importance of the effects of sedimentary and river-bed biofilms. An expression is developed that describes the relative activities of the suspended sediments with that of the riverbed biofilms in overall stream biogeochemical processes. That expression takes the general form of an activity ratio, R sub a, for the effect of suspended sediments compared with river-bed biofilm: R sub a = constant . (whf) divided by (ud) where w is the sediment loading; h, the stream depth; f, the thickness of the diffusion layer; u, the stream velocity; and d, the average particle diameter.

066375
HOFFMAN EJ, MILLS GL, LATIMER JS, QUINN JG * **Annual input of petroleum hydrocarbons to the coastal environment via urban runoff** . IN: Conf on Pollution in the North Atlantic Ocean, Halifax, NS, Oct 19-23, 1981 * Can J Fish Aquat Sci * 40(suppl 2) 41-53 * 1983.

To compile an oil pollution budget for Narragansett Bay, Rhode Island, urban runoff samples were collected at four storm drains each serving a different land use. Three to six storm events with different rainfall amounts were monitored at each drain, and the samples were analyzed for petroleum hydrocarbons using glass capillary gas chromatography. The hydrocarbon (HC) load for each storm (mass HC/area) varied systematically with total rainfall, and the storm event load - rainfall relationship was different for each land use. Using rainfall records, the load for each storm was calculated and then summed to predict an annual input rate of hydrocarbons to receiving waters in terms of mass HC/area for each land use. Industrial and interstate highway land gave the highest loads followed by commercial and residential land, respectively. Finally, an estimate of the total hydrocarbon annual input to Narragansett Bay via urban runoff was compiled using land use data from cities and towns in the drainage basin.

063445
HOLBROW C * **The Garrison Diversion, A personal view** * Freshwater Ctry * (5) 41-45 * Freshwater Fish Mark Corp, 1199 Plessis Road, Winnipeg, Man R2C 3L4 * 1981-05.

A report is given on a trip by concerned Manitobans to view the canals and control works that have been completed on the Garrison Diversion in North Dakota, and to express further opposition to the continuation of the project. At a news conference in North Dakota to publicize their opposition, the group emphasized that this American project would have dramatic and damaging effects on Canada. Despite the warning of the International Joint Commission and continued failures of the screen on McClusky Canal, U.S. Water Power and Resources Services continues to state that the fish screen will work. A detailed account of the tour is given.

066135
HOLLORAN M * **Model for instream regulation of radioisotopes and heavy metals in riverine waters subjected to a uranium mill discharge** . IN: Sediment/Freshwater Interaction, Proc 2nd Int Symp, Kingston, Ont, 15-18 June 1981 * Hydrobiologia * v91/92 175-188 * 1982-07-16.

In the Athabaska sandstone region of northern Saskatchewan, mining and milling of uranium-bearing ore is subjecting, and will continue to subject, surface waters to inputs of soluble heavy metals and uranium and thorium decay series radioisotopes. A mathematical simulation model was developed to assess the role of riverine sediments in regulating soluble concentrations of heavy metals and radioisotopes released to the environment through treated mining and milling process effluents. Specific elements studied included As, Ni, Pb, U, and Ra-226. The model considered that diffusion into sediment porewater and adsorption by sediment particulates from sediment porewater were the two dominant mechanisms regulating sediment loading. Experiments indicated that the equilibrium adsorption behaviour of the heavy metals and radioisotopes studied could be adequately explained using a linear adsorption isotherm, over the range of concentrations expected in the environment. Experimentally determined linear isotherm slopes ranged from 200 ml per g to 21 000 ml per g. Diffusion into the effective depth of the sediments (20 cm) was modelled using a quadratic (second order) driving force and a corresponding mass transfer coefficient. The model coefficients were calibrated using field and laboratory data. Results of the modelling suggested that the sediments have a small effect on instream concentrations during the active phases of mining and milling. The sediments were predicted to accumulate sufficient adsorbed mass, during the operational phase of mining and milling, to act as a distributed instream source after completion of milling activities. The significance of this post-operational source was a function of the initial effluent loading, elapsed time and site specific river characteristics.

065089
HOWELL G, LOCKERBIE D * **1982/83 St. Croix River water quality report** * IWD-AR-WQB-83-49

* 47p * Environ Can, Inland Waters dir, Atl Reg, Moncton, NB * 1983-10.

This report presents the results of the 1982-1983 Saint Croix River water quality monitoring program. The effluent discharge from the Georgia-Pacific Paper Mill at Woodland is shown to have considerable effect on the water quality parameters of the lower reaches of the river. However, with the exception of total alkalinity, stations below Woodland generally complied with the Saint Croix water quality objectives and national water quality guidelines. Values of dissolved oxygen and pH on all occasions appeared to be such that passage of the Atlantic salmon into the lower reaches of the river was possible. Major ion concentrations were found to be well related to both river discharge and specific conductance. Specific conductance in the lower reaches was proposed as an indicator of river oxygen demand and was shown to be well related to percent saturation of dissolved oxygen.

065091
HOWELL GD, LOCKERBIE DM * **St. Croix River water quality during the years 1965 to 1981** * IWD-AR-WQB-83-50 * 44p * Environ Can, Inland Waters Dir, Water Qual Branch, Atl Reg, Moncton, NB * 1983-10.

During the 1965-1966 period, the dominant major ion in the Saint Croix River was sulphate. However, this changed dramatically in 1966 when the Georgia-Pacific Pulp Mill shifted from the sulphite to the Kraft process. This resulted in a shift in ion dominance from sulphate to sodium and chloride. From the years 1966 to 1981 the overall major ion chemistry remained relatively constant. However, alterations to the pulping process did elicit some specific responses in water chemistry and the relationships between water quality parameters. During the period (1967-1972) when untreated Kraft effluent was discharged directly into the river, both the chemical composition and the discharge rate of the effluent were highly variable. This is reflected by the poor water quality-water quantity relationships. Although this variability was reduced with the adoption of primary effluent treatment in 1972, the most noticeable improvement corresponded to the adoption of the secondary treatment facility in 1977-1978. During the 1978-1981 period, there were good relationships between specific conductance and mean daily discharge as well as specific conductance and the major ions. In addition to regulating discharge rate and effluent composition, secondary treatment greatly improved the summer oxygen regime. Prior to 1978 summer oxygen minima were characteristically below 3.0 mg/L. However, secondary treatment, by lowering the river oxygen demand, improved the oxygen concentrations to levels near to the 5.0 mg/l water quality objective for the Saint Croix River.

066498
HUANG PM, OSCARSON DW, HAMMER UT, LIPINSKI NG, LIAW WK * **Dynamics of certain redox reactions of selenium in freshwater sediments** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

066138
HUANG PM, OSCARSON DW, LIAW WK, HAMMER UT * **Dynamics and mechanisms of arsenite oxidation by freshwater lake sediments** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

065858
HUBER DM * **Water quality monitoring of the Avon River - 1980, 1981** * Stratford/Avon River Environ Manage Proj Tech Rep S-3 * 51p * Ont Minist Environ, 985 Adelaide St South, London, ONt N6E 1V3 * 1982-08.

A two-year Stratford-Avon River Environmental Management Project included sampling conducted throughout the Avon River basin (tributary to the Thames River) to document the existing water quality. Most of the nineteen sampling locations were sampled approximately 30 times throughout the study period for various chemical and bacteriological parameters. The information collected revealed contamination of the river from both rural and urban sources. The highest levels of contamination occured during high river flow periods and were associated with erosion and poor farming practices. The Stratford sewage treatment plant also produced its poorest effluent during spring runoff and storm events. The rural areas contributed phosphorus, ammonia, nitrates, aluminum and bacteria to the Avon River, while the parameters of major concern resulting from sewage treatment were phosphorus, ammonia and bacteria.

067173
HUTCHINSON TC * **A historical perspective on the role of aluminum in toxicity of acidic soils and lake waters** , IN: Int Conf Heavy Metals in the Environment, Heidelberg, September 1983 * Mueller G (chairman) * 17-26 * CEP Consult Ltd, 26 Albany St, Edinburgh EH1 3QH GB * 1983.

Aluminium is presently receiving a great deal of attention as a key factor in fish deaths in acidifying lake waters. Studies have indicated that it precedes H^+ ions as a toxic factor in the pH range 6.0 to 5.0 as the pH declines. It has also been postulated as the major toxic element in those soils in Germany on which beech and spruce are dying. Everywhere that acid precipitation is being talked about or measured, aluminium is being postulated as the new 'toxic element'. The

large volume of data produced between 1900-1940 concerning Al as a key factor in crop reductions on agricultural soils, and the equally large, more recent information on Al in tropical acid sulphate soils seems to have been substantially ignored or been forgotten. To a large extent, the studies on aluminium as a controlling selective factor for plant growth and seedling establishment on naturally acidic soils also has often been ignored in the acid rain literature. In this presentation, an attempt is made to present a rather broad, synthetic overview of aluminium in the environment, and its role in determining toxicity to aquatic and terrestrial organisms.

062461
IHNAT M * **Copper, zinc, cadmium and lead in waters of selected southern Ontario agricultural watersheds** * Int J Environ Anal Chem * 11(3,4) 189-210 * 1982-06.

Concentrations of Cu, Zn, Cd and Pb were determined in stream waters of six agricultural watersheds in Southern Ontario draining into the Lower Great Lakes. Over all watersheds, samples collected during 1976 and the spring of 1977, had median concentrations plus or minus analytical standard error, of elements in dissolved form of 2.0 plus or minus 1.8 (range 0.5-18.5), 3.1 plus or minus 2.7 (range 0.1-11.4), 0.07 plus or minus 0.06 (range 0-0.57) and 0.1 plus or minus 0.2 (range 0-13.1) micro g/l for Cu, Zn, Cd and Pb respectively. Respective median total concentrations were 3.9 plus or minus 2.6 (range 2.4-445), 17.2 plus or minus 4.9 (range 4.3-2500), 0.08 plus or minus 0.02 (range 0.03-13.4) and 3.7 plus or minus 1.0 (range 0.9-433) micro g/l for Cu, Zn, Cd and Pb. Concentrations of elements in dissolved form were invariable with, whereas total concentrations were proportional to suspended sediment levels whose range was from 10 to 19,000 mg/l with a median of 20 mg/l. Mode of transport was found to depend on suspended sediment level. In waters with low suspended levels, below ca 20 mg/l, the majority of Cu and Zn was transported in dissolved form, whereas the suspended sediment accounted for most of the transport of these trace elements at higher particulate loads. Agricultural activities were estimated not to result in any gross contribution of these trace metals to the waters of these drainage systems.

063326
INT JT COMM. * **On phosphorus management strategies, Supplemental report, Under the Reference on Pollution in the Great Lakes System from Land Use Activities** * 24p * Int Jt Comm, 100 Metcalfe St, 18th Floor, Ottawa, Ont K1P 5M1 * 1981-01-30.

The International Joint Commission confirms that the target loads contained in Annex 3 of the 1978 Great Lakes Water Quality Agreement are the best estimates available at the present time of maximum annual phosphorus loads that would achieve the goals in the Agreement. If the target loads are adopted, the Commission presents one strategy to reach them, primarily an expansion of the strategy that PLUARG found to be the most cost effective of the measures studied. The Commission notes that other cost-effective strategies to achieve the target loads may also be possible. The Commission further notes that the target loads were based primarily on scientific and technical considerations. Other factors that might be further considered in the development of the target loads and programs to meet them, include the projected impacts of present control programs, biological availability, nearshore problems, and socio-economic considerations. The Governments are committed to confirming the target loads by May 22, 1981, by which time they should also determine the need to study these factors further. If further consideration of any of these factors is required, an intensive study program is recommended, together with an interim strategy of phosphorus management, essentially that proposed by the IJC Task Force on Phosphorus Management Strategies. This recommended program, which would be the required minimum strategy in either case, includes both point and non-point controls, the retention of the detergent phosphate limitation, and its expansion to all Great Lakes Basin jurisdictions.

064173
JACKSON MB * **Winter oxygen loss in three southern Ontario lakes** , IN: Studies in snow and ice (a collection of student research papers and essays) * ROULET NT * Trent Stud Geogr, vol 8 * 149-159 * Trent Univ Geogr Soc, Trent Univ, Peterborough, Ont * 1980.

The purpose of this report is to describe and quantify winter whole-lake respiration and its component parts under ice cover in Lake St. George, Coon Lake and Big Cedar Lake, three small southern Ontario lakes. The lakes were selected primarily to ensure a range in lake types having low flushing rates and measurable oxygen loss. Factors contributing to whole-lake oxygen loss under ice cover are described. The role that a winter cover of a lake plays on the oxygen dynamics of these lakes is examined.

066139
JACKSON TA, PARKS JW, JONES PD, WOYCHUCK RN, SUTTON JA, HOLLINGER JD * **Dissolved and suspended mercury species in the Wabigoon River (Ontario, Canada): seasonal and regional variations** , IN: Sediment/Freshwater Interaction, Proc 2nd Int Symp, Kingston, Ont, 15-18 June 1981 * Hydrobiologia * v91/92 473-487 * 1982-07-16.

Seasonal and regional variations in the

speciation, sediment-water partitioning, and dynamics of mercury (Hg) were studied at selected sites along the Hg-polluted Wabigoon River, and at unpolluted headwater and tributary sites, during April-September, 1979. 'Dissolved' and 'particulate' forms of Hg in the water were separated by continuous-flow centrifugation in the field. The Hg and other pollutants such as wood chips and salt had been discharged from a chlor-alkali plant and paper mill at Dryden, Ontario. Concentrations and loadings of particulate methyl mercury (CH_3Hg^+) and total particulate Hg (and loadings of total 'dissolved' Hg) were greatest during the spring flood (April-May). Concentratons of 'dissolved' CH_3Hg^+ were highest in the summer (July-September). Total dissolved Hg concentrations were relatively high in September. Loadings of dissolved CH_3Hg^+ tended to be high in the summer but were generally depressed during the major spring-flood episode in May. During July-August dissolved CH_3Hg^+ was a function of total dissolved Hg, suggesting rapid biomethylation of desorbed inorganic Hg; but in general dissolved and suspended CH_3Hg^+ levels depended on environmental variables and were unrelated to total Hg concentrations. In the summer only, total dissolved Hg was a function of dissolved Cl^-. Hg species in particulates were associated with sulfides, hydrated iron and manganese oxides, organic matter (notably high molecular weight humic and humic-iron components), and selenium (Se); but CH_3Hg^+ and total Hg differed in their specific preferences for binding agents, implying that binding sites discriminate between CH_3Hg^+ and Hg sup 2+ ions. CH_3Hg^+ was associated with sulfide and (in the spring only) with iron oxides, whereas total Hg was associated with organic matter and Se and with DTPA- and NaOH-extractable iron in the spring but with Mn oxide and NaOH-extractable organics in the summer. Sulfides were most abundant in May, indicating that they were eroded from bottom sediments, but iron and manganese oxides were most abundant in the summer, probably owing to activities of filamentous iron bacteria and other micro-organisms. The results indicate that in any pollution abatement plan aimed at lowering the Hg levels in the biota of lakes fed by the Wabigoon River, immobilization, removal, or detoxification of dissolved as well as particulates forms of Hg in the river would probably have to be considered. Possibly, Hg species could by 'scrubbed' from the river water by increasing the suspended load and by sedimentation and treatment with Hg-binding agents in special receiving basins.

065594
JAMES W * **Computer modelling of Hamilton's urban drainage system** (see chapter 4.3 for complete reference - voir chapitre 4.3 pour la reference complete)

065595
JAMES W, HENRY D * **Development of a stormwater overflow model for pollutional loadings to Hamilton's receiving waters, summer field program and data for period May to October 1981** (see chapter 4.3 for complete reference - voir chapitre 4.3 pour la reference complete)

065598
JAMES W, MITRI H * **SWMM compatible algorith for side-weir structures** (see chapter 4.3 for complete reference - voir chapitre 4.3 pour la reference complete)

065781
JAMES W, SHIVALINGAIAH B * **Stormwater quality and atmospheric pollution modelling in an industrial city** , IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * v2 707-722 * Can Soc Civ Eng * (1983).

The location of the industrial areas, the direction, velocity and duration of wind and the source concentrations are important parameters in the prediction of atmospheric fallout, a component of surface pollutant loadings. In the paper, observed isopleths of dustfall are correlated with these parameters and superimposed on the discretized subcatchments for a comprehensive stormwater quality management model, SWMM3. The water quality algorithms in SWMM3 have been enhanced to include atmospheric fallout, street sweeping time series data, separation of pollution source areas, variable time step hydrology and moving storm analysis. Model results are presented for some of these enhancements and compared with observed loadings in Hamilton.

065869
JASPER S, GRAY CBJ * **The chemical and microbiological limnology of Wood Lake, B.C., 1980** * 107p * Environ Can, Environ Conserv, Inland Waters Dir, Pac & Yukon Reg, Vancouver, BC * 1982-04.

This report describes a small limnological study of Wood Lake, B.C. carried out by the National Water Research Institute, Pacific and Yukon Region, in 1980. At a mid-lake station the temporal distributions of temperature, light extinction, dissolved oxygen, nutrients metals, chlorophyll a, ATP, phytoplankton species composition, phosphorus turnover time and alkaline phosphatase activity were determined. In addition, a survey of the spatial distribution of dissolved oxygen and nutrients in the bottom water was completed in September and sediment cores were obtained from the mid-lake station. Of the three major phytoplankton nutrients it appears that phosphorus (P) ultimately controls the annual yield of biomass. On the basis of water clarity, oxygen depletion rates, N to P ratios

and phytoplankton biomass and species composition, Wood Lake, in 1980, would be classed as mildly eutrophic. However, normal inter-annual variability may modify the magnitude and distribution of some of these parameters.

066860
JEFFRIES DS, SEMKIN RG * **Changes in snowpack, stream, and lake chemistry during snowmelt in the Turkey Lakes watershed** * Can Cent Inland Waters Unpublished Rep Ser 83-4 * 24p * Environ Can, Natl Water Res Inst * 1983-06.

The effect of snowmelt on the chemistry of surface waters in the Turkey Lakes watershed was studied for 1981 and 1982. In 1982, a mid-February melt preceded the major runoff event that was initiated by heavy rainfall in late March. The runoff hydrograph contained several sharp peaks of intense stream discharge. In 1982, a large snowpack accumulated and was affected by 2 small melt periods in April prior to maximum runoff. The hydrograph was characterized by broad, low intensity peaks in stream flow. Ionic pollutants stored in the snowpack were rapidly and preferentially (with respect to water) removed at the beginning of melting periods. The loss of acid from the snowpack was reflected in streamwater pH depressions. The magnitude of the depression was a function of stream discharge. Maximum H+ concentrations in 1981 followed peaks in stream discharge rather than preceding them as has been observed in Norwegian studies. Interaction of the acidic meltwaters with the deeper, unfrozen soils present in the Turkey Lakes Watershed may account for the different observations in the two locations. In 1982, Batchawana Lake experienced 2 separate periods when surface water pH declined to less than 5.0 from mid-winter values of approximately 6.2. Sulphate, CA2+, NO3- and NH4+ also varied in a predictable manner given the relative concentrations in the snowpack and lake water.

F10211
JONES HG, DUELLET M * **Caracteristiques physico-chimiques et microbiologiques de la couverture de glace de quelques lacs** (see chapter 6.1 for complete reference - voir chapitre 6.1 pour la reference complete)

066164
JONES R, ORR DB * **Freeze-out of nutrients from lake ice** . IN: Proc Thirth-seventh Annual Eastern Snow Conf, June 5-6, 1980, Peterborough, Ont * GOODISON BE * 193-195 * (1980).

This paper describes an in situ sampling device to collect water samples from beneath developing ice cover. A plexiglass sample box was frozen into the ice cover of Dummer Lake by clearing a hole through the ice cover and by forcing the box down into the water with a weight suspended from its bottom. To collect a water sample from beneath the ice, a hand held 10 ml Vacutainer with a needle inserted through the stopper was lowered to the required depth as measured with a metre stick. The sleeve needle was pushed through the hole against the rubber seal causing the needle to enter the water column and the tube to fill with water. In this way a sequential depth series of water samples was collected.

066189
JOSEPH HC * **A study of heavy metal transport in irrigation return flows of southern Alberta** * 211p * 1982-05.

With the identification of agriculture as a major contributor of pollutants to receiving waters, knowledge has gained rapidly on the quantity and quality of many contaminants. Heavy metals in agricultural drainage waters are perhaps least understood. Of particular relevance is the identification of chemical forms of heavy metals that are biologically available. Examination of irrigation return flows in semi-arid southern Alberta provided an opportunity to investigate heavy metal fluxes and chemical transport mechanisms in a unique agricultural setting. The characterization of the pollutant contributions from other agricultural areas can perhaps be approximated from this area. Seven irrigation return flows and one distribution canal were sampled for unfiltered and filtered waters, as well as suspended solids material (using a continuous-flow centrifuge on-site). Samples were collected during June, July, August and September. All water and sediment samples were analyzed by Atomic Absorption Spectrophotometery for total (HNO3-HCl digestion) concentrations of Cu, Mn, Zn, Fe, Co, Ni, Cr, Cd and Pb. Selected suspended solids samples were further analyzed using partial chemical extractions of 0.5M MgCl2, 2.5% HCl and 10% HCl. Statistical and graphical analysis of heavy metal concentrations of all samples, demonstrated minimal fluctuation throughout the season, and little variation between sampling sites. A consistent ordering of metal concentrations was noted: Fe greater than Mn greater than Zn greater than Cu for all samples. Partial chemical analyses demonstrated a very small percentage of suspended solids-associated metals to be readily available for aquatic biota. Large quantities of all heavy metals are associated with the residual fraction. Thus heavy metal contributions to receiving waters of the Bow and Oldman Rivers are primarily non-available to biota and are at levels very similar to surrounding agricultural soils.

066861
KAISER KLE * **Chemistry and the environment: problems and answers** * Natl Water Res Inst Unpublished Manuscr Rep Numbered Ser 83-5 *

24p * Environ Can, Natl Water Res Inst, Burlington, Ont L7R 4A6 * (1983).

This report discusses the environmental problems associated with the widespread use of chemical compounds. As an example the contamination of the Great Lakes is described. Two major thrusts of ongoing analytical and biological research which may alleviate future contamination problems are discussed. They are the sensitive and inexpensive analytical measurements providing quick results on the levels and trends of known contaminants, and simple and effective tests to help predict potential environmental behavior and biological effects of contaminants. The need for and potential benefits of quantitative structure-activity correlations research in environmental toxicology are also considered.

063641
KAISER KLE, COMBA ME * **Volatile contaminants in the Welland River watershed** * J Great Lakes Res * 9(2) 274-280 * 1983.

Surveys of selected volatile contaminants in water of the Welland River, a tributary to the Niagara River, in 1980 and 1981 show high levels of carbon disulfide, methylene chloride, and chloroform immediately below two industrial outfalls. Downstream from these point sources, a rapid decline in the contaminant concentrations is noted due to dilution, degradation, and/or volatilization of the compounds. Although toxic effects of other components of these effluents have been observed, the concentrations of the volatile contaminants are several orders of magnitude lower than those at which acute toxic effects on biota are observed.

063636
KAISER KLE, COMBA ME, HUNEAULT H * **Volatile halocarbon contaminants in the Niagara River and in Lake Ontario** * J Great Lakes Res * 9(2) 212-223 * 1983.

Water samples from 95 stations in Lake Ontario and 16 stations in the lower Niagara River were analyzed for volatile halocarbons and carbon disulfide. The following contaminants were observed at many stations with their lake-wide means and standard deviations: trichloro-fluoromethane (Freon 11), 249 plus or minus 882 ng. per L; methylene chloride, 572 plus or minus 1,826 ng. per L; chloroform, 18 plus or minus 92 ng. per L; bromodichloromethane, 3 plus or minus 9 ng. per L; and tetrachloroethylene, 9 plus or minus 65 ng. per L. Eleven other compounds, including carbon disulfide, 1, 1-dichloroethylene, 1,1,1-trichloroethane, carbon tetrachloride, and tetrachloroethylene were observed at trace levels or absent at most stations. Six compounds were observed in virtually all Niagara River samples and were traceable into the lake. As apparent from the large relative standard deviations for the above, contaminant concentrations varied strongly between stations, indicating areas of contaminant sources. Both industrialized and urban areas, such as Toronto, Hamilton, and the Niagara River, as well as comparatively small tributaries, such as Twelve Mile, Eighteen Mile, and Oak Orchard Creeks, Black River, and the Welland Canal, appear to be sources for several of the observed contaminants.

063044
KALIN M * **Long-term ecological behaviour of abandoned uranium mill tailings 1. Synoptic survey and identification of invading biota** * Technol Dev Rep EPS 4-ES-83-1 * 130p * Environ Can, Environ Prot Serv, Ottawa, Ont K1A 1C8 * 1983.

Inactive uranium mill tailings were surveyed in the Province of Ontario to describe their surface characteristics, identify naturally invading biota, and determine essential chemical and physical parameters associated with the tailings. Vegetation stands in which inactive tailings sites can have wet areas, tailings completely covered with water, and dry areas, are described. Elemental concentration and some physical characteristics of the tailings collected from a depth of 0-20 cm were determined. The concentrations of calcium and uranium were found to have extremely large variations. Concentrations of aluminum, copper, cobalt, magnesium, manganese and nickel in the tailings were less varied. The elements sodium and lead are possibly enriched in the tailings of the Bancroft area compared to mineral soils from the same area, and to soils in general. For the tailings in the Elliot Lake area, aluminum, chlorine, magnesium and nickel were determined in concentration ranges typical of soils, but manganese and sodium were depleted in the surface of those tailings. Lead concentrations in the tailings were elevated in this area. A comparison of electrical conductivity, loss-on-ignition and moisture loss of tailings with that of soils, suggests that tailings differ drastically in these characteristics. Uptake of heavy metals and radio-nuclides was evaluated in trees found in the dry areas and cattails in the wetland areas. Water bodies on tailings and surface water leaving the tailings, before and after treatment, were characterized in this survey. It was found that aquatic bryophytes have invaded some water bodies on the tailings, and acid tolerant algae were evident in most of the water associated with the tailings.

063632
KAMINSKY R, KAISER KLE, HITES RA * **Fates of organic compounds from Niagara Falls dumpsites in Lake Ontario** * J Great Lakes Res * 9(2) 183-189 * 1983.

Sediment samples from the western portion of Lake Ontario were analyzed for chlorinated

organic compounds using gas chromatography and gas chromatographic mass spectrometry. Both electron impact and negative chemical ionization mass spectrometry were employed. Many of the chlorinated compounds previously found to be leaking into the Niagara River from waste disposal sites in the city of Niagara Falls were identified in the sediments of Lake Ontario. In particular, two unique chlorofluorinated compounds were founded in the lake's sediment, showing that stable compounds introduced into the Niagara River accumulate to detectable levels 100 km away in Lake Ontario. Chlorinated styrenes as well as several highly chlorinated polycyclic aromatic hydrocarbons were also found. Their exact origin is uncertain at this time.

063231
KAUSHIK NK, SOLOMON KR (ED) * **Proceedings of the Eighth Annual Aquatic Toxicity Workshop: November 2-4, 1981, Guelph, Ontario** * Can Tech Rep Fish Aquat Sci 1151 * 266p * Dep Fish Oceans, Fish Habitat Manage Branch, Ottawa, Ont * 1983-03.

The Workshop provided a forum for informal discussion on subjects relevant to aquatic toxicity, with particular reference to the Canadian and North American environments. In addition to these discussions, the Workshop also provided a forum for the presentation of the results of scientific research and study. The papers submitted were grouped into the major areas of: effects of pesticides and other pollutants in aquatic systems, acid precipitation, toxikinetics, single organism bioassay techniques, and environmental interactions of pollutants. Included are extended abstracts, program extracts and Workshop summaries that were not subjected to external review, and published as received, as well as a survey of aquatic toxicity research.

063640
KAUSS PB * **Studies of trace contaminants, nutrients, and bacteria levels in the Niagara River** * J Great Lakes Res * 9(2) 249-273 * 1983.

Sediment and water quality of the Niagara River were investigated during 1979 and 1980 to determine spatial and temporal differences in the levels of trace contaminants (heavy metals, phenolics, PCBs, and organochlorine pesticides) as well as nutrients and bacteria. Data from these studies as well as recent biomonitoring studies indicate that the Niagara River continues to be a source of such contaminants as PCBs, BHCs, mirex, and heavy metals to Lake Ontario. The major source of the contaminants is the highly industrialized and urbanized Tonawanda Channel area in the upper section of the river. Although a substantial improvement in phenolics levels was noted in the river since earlier surveys in 1971, bacterial and phosphorus levels show no significant changes, particularly near the U.S. mainland shore of the Tonawanda Channel and near the Buffalo River mouth.

064580
KELSO B, JONES M * **A data report on water quality and biological data from the receiving waters of the area around the Placer Mining Development Endako Mines Division Francois Lake** * Reg Program Rep 83-07 * 105p * Environ Can, Environ Prot Serv, Environ Prot Branch, Pac Reg * 1983-02.

In 1981, Placer Development Limited, Endako Mines Division, applied for an amendment of their Pollution Control Permit No. PE-1307, to allow for discharges from their new Ultra Pure plant and to a new No. 3 tailings pond. Seepages from the No. 1 and No. 2 tailings ponds were entering the Endako River, Stellako River, and Francois Lake, and little information had been gathered on the impact on the environment of these seepages. Therefore a sample program was initiated by the Environmental Protection Service to determine if these discharges were of significant concern. This report is a compilation of the data collected. Sampling was done of: water chemistry, sediments, macroinvertebrates, phytoplankton, zooplankton, and fish. The physical and chemical results are tabulated, including concentrations of heavy metals in the tailings ponds seepage and in the rivers.

067138
KELSO BW, JONES M * **Progress report on the December 7, 1982 water quality sampling in Myra Creek after the implementation of the groundwater and surface collection and treatment system at Westmin Resources Limited on Vancouver Island** * Reg Prog Rep No 83-18 * 33 * 6 ref, 11 tab, 1 fig * 1983-07.

This report gives the results of the sampling done in Myra Creek, British Columbia, during a site visit and monitoring program on December 7, 1982, of the collection and treatment system at Westmin Resources Limited on Vancouver Island, British Columbia. Data collected show a significant loading of copper and zinc to Myra Creek. The sample site at the beginning of the collection site had a loading of total zinc and copper of 67.0 and 5.87 kg/day respectively. Loadings of zinc and copper between the beginning and end of the collection system increated to 81.3 kg/day and 6.53 kg/day respectively. Most of the loading is shown to be coming from the mine site above the collection system. Comparison of loadings before and after the installation of the collection system also show that the treatment system is working.

F11425
KHAN NY * **Evaluation des pesticides au ministere des Peches et des Oceans** , IN: Atelier sur les pesticides, compte rendu, 8-11 mars 1982, Toronto, Ont * 105-110 * Cons can

minist des ressources et de l'environ * 1982-03.

Le ministere des Peches et des Oceans est charge de la conservation et de la protection des poissons et de leur habitat en vertu de la Loi des pecheries. Cette responsabilite confere au ministere le role vital de conseiller aupres du ministere de l'Agriculture en matiere d'homologation et de reglementation des pesticides. La Division des dangers des produits chimiques de la Direction de la gestion de l'habitat du poisson, a Ottawa, examine les demandes d'homologation. On evalue les donnees fournies par l'industrie ainsi que les donnees disponibles dans diverses bases de donnees pour determiner les niveaux d'exposition du milieu aquatique aux pesticides et leur incidence toxique probable sur les ecosystemes aquatiques.

066136
KLAPWIJK A, SNODGRASS WJ * **Experimental measurement of sediment nitrification and denitrification in Hamilton Harbour, Canada** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

064897
KORSTAD J * **Nutrient regeneration by zooplankton in southern Lake Huron** * J Great Lakes Res * 9(3) 374-388 * 1983.

Rates of nutrient regeneration by zooplankton (micro mol/mg dry wt/hr) in southern Lake Huron from April to August 1975 ranged from undetectable to 2.6 for total phosphorus (TP), undetectable to 0.8 for total soluble phosphorus (TSP), undetectable to 0.12 for soluble reactive phosphorus (SRP), undetectable to 0.97 for ammonia (NH3), undetectable to 3.8 for nitrate plus nitrite (NO3 + NO2), and undetectable to 2.9 for silica (SiO2). Two diel experiments were conducted. Times of highest rates of regeneration varied for the different nutrients on these dates. Using the average concentration of zooplankton in the surface waters during this study, the calculated average concentration of nutrients regenerated by zooplankton was 0.012 micro mol P/L/hr for TP, 0.0046 micro mol P/L/hr for TSP, 0.0016 micro mol P/L/hr for SRP, 0.0146 micro mol N/L/hr for NH3, 0.043 micro mol N/L/hr for NO3 + NO2, and 0.058 micro mol Si/L/hr for SiO2. The contribution of nutrient regeneration by zooplankton to the turnover time of the various nutrients in the surface waters was calculated to be 212 hr for TP, 239 hr for TSP, 69 hr for SRP, 62 hr for NH3, 505 hr for NO3 + NO2, and 531 hr for SiO2. Although the turnover time for most of these nutrients is fairly slow, the nutrient pools for SRP and NH3 are replenished in less than 70 hr by nutrient regeneration. Zooplankton therefore appear to play a significant role in the cycling of SRP and NH3 in southern Lake Huron.

F10686
KUNTZ KW, CHAN CH * **Qualite de l'eau dans la haute Niagara, 1975 et 1979** *Etude no 129, Ser sci * 24p * Environ Can, Dir gen eaux inter, Reg Ont, Dir qual eaux, Burlington, Ont * 1982.

En 1975 et en 1979, on a preleve des echantillons d'eau de surface dans la haute Niagara pour analyser un large eventail de parametres comprenant les elements nutritifs, les principaux ions, les metaux en traces, les contaminants organiques toxiques et des parametres microbiologiques. Les resultats ont indique que la concentration des elements nutritifs et des metaux en traces de meme que les parametres bacteriologiques etaient plus eleves dans le chenal Tonawanda que dans le chenal Chippawa. La concentration des principaux ions n'a pratiquement pas change entre 1975 et 1979. Celle des elements nutritifs n'a pas varie sauf que la concentration de l'azote nitrique a augmente et celle des particules de carbone organique a diminue. La teneur en fer total ainsi que le nombre de coliformes totaux et de coliformes fecaux dans le chenal Tonawanda excedaient les objectifs de qualite de l'Accord Canada - USA de 1972 relatif a la qualite de l'eau dans les Grands lacs.

063639
KUNTZ KW, WARRY ND * **Chlorinated organic contaminants in water and suspended sediments of the lower Niagara River** * J Great Lakes Res * 9(2) 241-248 * 1983.

Suspended sediment and raw water samples have been collected and analyzed for organochlorines and PCBs from a fixed location in the lower Niagara River at Niagara-on-the-Lake approximately weekly since 1979. Eight of the 19 organochlorine compounds measured were detected in more than 50% of the water samples analyzed, while 11 of the 19 compounds were detected in more than 50% of the suspended sediments collected at Niagara-on-the-Lake. Of the 10 chlorobenzene isomers measured, the one with the greatest usage (1, 4-dichloro) occurs in largest concentrations in the suspended sediments at Niagara-on-the-Lake. Other chlorobenzene isomers commonly occurring in suspended sediments are 1, 2 and 1, 3 dichloro, 1, 2, 4-trichloro, 1, 2, 3, 4-tetrachloro, pentachloro, and hexachloro. All isomers of chlorobenzene occurred in more than 70% of the suspended sediment samples collected. Total loadings to Lake Ontario calculated from these data indicate that PCB loadings are about twice as high as previously reported, while mirex and total DDT have decreased slightly. Although concentrations of contaminants in suspended sediments are usually higher than those measured in water samples, they are responsible for only about 40% of the total loadings for PCBs, DDT, and HCB, and significantly less for other organochlorine contaminants. Therefore, the data indicate that, to estimate the total

contaminant loadings, the water fraction must be sampled. Lake Erie is not the major source of such organic contaminants as PCBs and chlorobenzenes because contaminant levels in Lake Erie bottom sediments are 10 times lower for PCBs and 20 times lower for chlorobenzenes than in Niagara-on-the-Lake suspended sediments.

062362
KWASNIEWSKA K * **The degradation of pentachlorophenol by a fungus of Fusarium sp.** , IN: Trace Substances in Environmental Health-XV, Proc 15th Annual Conf on Trace Substances in Environmental Health, Columbia, MO, June 1-4, 1981 * HEMPHILL DD * 392-398 * 1981.

Pentachlorophenol (PCP) and its sodium salt have commonly been used for the control of certain weeds, fungi, insects and slimes. Due to its moderate resistance to biodegradation, PCP may accumulate in some parts of the aquatic environment. Fungi are present abundantly in the aquatic ecosystem and may be involved in the ultimate degradation of PCP and other environmental contaminants. A fungus of Fusarium sp. selected from Guelph silt loam soils was used as the test organism. The degradation measurement was based on the disappearance of PCP both from the supernatant of the growth medium and the fungal biomass (mycelium) itself. The results indicate that the fungus Fusarium sp. grown in liquid malt extract medium with L-tyrosine and 20 ppm of PCP was able to degrade this biocide rapidly (25% in 4 days, 75% in 11 days). The same fungus grown in a mineral medium without tyrosine showed no apparent degradation of PCP even after 18 months of incubation. The importance of tyrosine in degradation of PCP is discussed.

062325
KWIATKOWSKI RE * **Trends in Lake Ontario surveillance parameters, 1974-1980** * J Great Lakes Res * 8(4) 648-659 * 1982.

Data from 66 cruises on Lake Ontario, sampling some 95 stations, were subjected to trend analysis. The data were reduced to monthly means and statistically significant (P greater than or equal to) decreases in total phosphorus (TP), chlorophyll a, and particulate organic carbon (POC) were observed between 1974 and 1980. Seasonally corrected trend-in-time equations were formulated for the 17 zones established by the International Joint Commission for five commonly measured surveillance parameters (temperature, TP, chlorophyll a, POC, and chloride). In general, offshore areas produced seasonally corrected trend-in-time equations with higher coefficients than did nearshore areas, indicating that the offshore areas have been more stable during the historical period studied.

F11591
KWIATKOWSKI RE, NEILSON MAT * **Donnees recueillies lors de la surveillance du lac Ontario (1968 a 1980)** (see chapter 4.4 for complete reference - voir chapitre 4.4 pour la reference complete)

065926
LAKSHMAN G * **Surface water pollution from intensive livestock operations** (see chapter 8 for complete reference - voir chapitre 8 pour la reference complete)

F11850
LALIBERTE D, GOULET M * **Pesticides organochlores: contamination du milieu aquatique au Quebec meridional** * Q.E.-54 * 73p * Minist Environ, Dir gen invent et rech, Que * 1983-12.

Cette etude donne un premier apercu de la contamination generale du milieu aquatique au Quebec par douze pesticides organochlores: aldrine, dieldrine, DDD, DDE, DDT, endrine, epoxyde d'heptachlore, heptachlore, HCB, lindane, methoxychlore, mirex. Des echantillons de mollusques et de poissons ont ete recueillis a l'ete 1978; les cinq pesticides furent retrouves dans pratiquement tous les echantillons. Cependant, seuls le DDT, le DDD et la dieldrine ont ete detectes dans presque tous les echantillons de pelecypodes. Les resultats detailles par composantes sont presentes a l'annexe I.

062393
LAM DCL, SCHERTZER WM, FRASER AS * **Mass balance models of phosphorus in sediments and water** * Hydrobiologia * v91 217-225 * 1982.

Models are presented in order of progressively more complex spatial resolution in which the effects on the sediment-water interactions are emphasized. For simple models, the diagnostic approach of calculating the net settling and return of total phosphorus is demonstrated with data from Lake Erie. For more complex models, the effects of interbasin transport and vertical mixing are shown to be important in determining the pathways of the sediment-released or sediment-bound phosphorus in the water column.

063391
LAM DCL, SCHERTZER WM, FRASER AS * **Simulation of Lake Erie Water quality responses to loading and weather variations** * Sci Ser No 134 * vp * Natl Water Res Inst, Inland Waters Dir, Can Cent Inland Waters, Environ Can, Burlington, Ont * 1983.

This report presents simulation results and observational data relating to the water quality conditions of Lake Erie for the twelve-year period from 1967 to 1978. In an attempt to explain the large seasonal variations manifested in the observations,

detailed weather records were used to reconstruct, through computer simulation, the thermal stratification regimes in the lake. By allowing the thermal layer thicknesses to change dynamically, the mass balance models can now simulate accurately weather-dominant phenomena in the lake. Specifically, regular seasonal patterns in dissolved oxygen in the epilimnion and irregular patterns of anoxic chemical regeneration of soluble reactive phosphorus were both found to be in accordance with well-defined prevailing weather conditions. Similarly, modelling of interbasin transport, vertical entrainment and wind-wave resuspension has led to improvement in the long-term simulation of total phosphorus concentrations. Indeed, from the twelve-year simulations and observations, it is concluded that lake total phosphorus concentration has decreased, primarily in response to the phosphorus removal program. However, even with the inclusion of detailed meteorological influences, the simulation of dissolved oxygen response to the phosphorus removal program remains, at best, a rough guess; better long-term loading and sediment chemistry data are required to find more definitive answers. In the meantime, preliminary estimates of these water quality responses are provided for averaged weather conditions, and to underscore their limitations, probable responses to favourable and adverse weather are also presented.

065813
LANG GA * **The Mineral River - a unique tributary chloride load to Lake Superior** * J Great Lakes Res * 9(4) 584-587 * 1983.

The Mineral River contributes a significant amount of chloride to Lake Superior, more than one-third of the total U.S. tributary input. This unique discharge is attributed largely to the mine dewatering process of the White Pine Copper Company. Chloride concentrations as high as 2,000 mg/L have been recorded at the mouth of the Mineral River. The impact of this discharge on Lake Superior is not known; however, it is postulated that increased chloride concentrations may enhance the introduction and adaptation of marine organisms into the Great Lakes.

065908
LANGSTON WJ * **The behavior of arsenic in selected United Kingdom estuaries** (see chapter 4.8 for complete reference - voir chapitre 4.8 pour la reference complete)

F10890
LAPERLE M * **La protection de l'environnement au Complexe La Grande** (see chapter 4.5 for complete reference - voir chapitre 4.5 pour la reference complete)

065466
LAST WM, SCHWEYEN TH * **Sedimentology and geochemistry of saline lakes of the Great Plains** , IN: Saline Lakes, Proc 2nd Int Symp on Athalassic (Inland) Saline Lakes, Saskatoon, Sask, June 24-28, 1982 * HAMMER UT * Hydrobiologia * v105 245-263 * 1983-09-01.

Southern Saskatchewan and portions of adjacent Alberta, North Dakota and Montana are occupied by hundreds of saline and hypersaline lakes ranging in size from small prairie potholes (less than 1 sq km) to relatively large bodies of water (greater than 300 sq km). From a sedimentological perspective, distinction must be made between two basic types of saline lakes; playas and perennial lakes. Calcium, sodium and magnesium sulfates, carbonates and bicarbonates form as chemical precipitates in lakes with more concentrated brines. In addition, experimental data suggests mixed layer smectites may form authigenically in some lakes. Clastic sediments in the salt lakes consist mainly of silt and clay-sized quartz, feldspars, carbonates and clay minerals. The dominant physical and chemical processes which are responsible for and act upon the sediment vary widely, mainly in response to basin morphology and brine chemistry. Evaporative concentration and significant groundwater contributions affect all the saline lakes. However, other processes are different in the two basic types of basins. The playa lakes are influenced by: evaporitic pumping and the formation of efflorescent crusts and intrasedimentary crystals, cyclic wetting and drying, precipitation of highly soluble salt layers, and influx of clastic debris by sheetflood and wind. In contrast, in the permanent lakes, precipitation of sparingly soluble salts occurs due to the interaction of biological activity, seasonal temperature fluctuations and brine mixing. In addition, many of the permanent lakes undergo freeze-out precipitation of very soluble salts under a winter ice cover. Detrital sediments are distributed within the basins by normal lacustrine processes, including shoreline deposition and erosion, turbidity flow and pelagic fallout.

064860
LAZERTE BD * **Stable carbon isotope ratios: implications for the source of sediment carbon and for phytoplankton carbon assimilation in Lake Memphremagog, Quebec** * Can J Fish Aquat Sci * 40(10) 1658-1666 * 1983-10.

The stable carbon isotope (SCI) ratio of the sediment of Lake Memphremagog, Quebec is compared with that of terrestrial sources and the phytoplankton to determine the relative proportion of allochthonous carbon incorporated into the sediments. Approximately 40-50% of the organic carbon in the main basins' pelagic sediment was terrestrial in origin, whereas up to 100% was terrestrial in littoral areas. The SCI method

of determining the organic carbon source of sediments appears more reliable than the C/N method. A comparison of the SCI fractionation of the phytoplankton with laboratory cultures under different degrees of carbon limitation indicates that the phytoplankton of Lake Memphremagog are not carbon limited and fix carbon primarily by the C sub 3 pathway.

064907
LEDUC R, MCBEAN EA, UNNY TE, KARMESHU K * **Comment on "Random differential equations in river water quality modelling" by B.A. Finney et al** * Water Resour Res * 19(5) 1334-1336 * 1983-10.

This note comments on the value of the PSSAM model developed by B.A. Finney and others in river water quality modelling as it considers many parameters of river flow and uses stochastic differential equations. However, it is pointed out by the note's writers that the PSSAM has two major limitations: in-stream oxygen demand caused by nitrification has been neglected; and, a different approach to stochastic differential equations would produce different results and lead to markedly different formulations. Future research avenues to investigate with stochastic differential equations, are presented.

062473
LEE GF, JONES RA * **Assessing environmental impacts of open water disposal of dredged sediment** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

F10218
LEE HB, CHAU ASY * **Etude nationale interlaboratoires no 27 de controle de la qualite; les BPC dans les sediments naturels pollues asseches** * Etude no 72, Ser rapp gen * 10p * Environ Can, Inst natl rech eaux, Dir gen eaux inter, Cent can eaux int, Burlington, Ont * 1981.

Le present rapport decrit une etude interlaboratoires du dosage des biphenyles polychlores (BPC) dans des echantillons de reference constitues de sediments naturels pollues qu'on a fait secher et dans des solutions d'isooctane. Les resultats ont varie fortement d'un laboratoire a l'autre. Parmi les laboratoires les plus comparables, le coefficient de variation (C.V.) moyen est de 29,0%, ce qui est beaucoup plus grand que celui (16,2%) de l'Etude interlaboratoires no 25 du controle de la qualite, qui portait sur l'analyse de sediments contenant des ajouts de BPC. Les resultats moins fiables de la presente etude decoulent probablement des interferences et des difficultes de recuperation et de dosage de melanges de BPC.

F10237
LEE HB, CHAU ASY * **Etude nationale interlaboratoires no 25 de controle de la qualite; les BPC dans les sediments humides** * Etude no 71, Ser rapp gen * 9p * Environ Can, Inst natl rech eaux, Dir gen eaux inter, Cent can eaux inter, Burlington, Ont * 1981.

Dans la presente etude, on compare les resultats du dosage par differents laboratoires de concentrations d'environ 1 mg/kg de biphenyles polychlores (BPC) (un melange 1:1 d'Aroclor 1254 et d'Aroclor 1260) dans des echantillons de 10 a 20 g de sediments humides. Le coefficient de variation moyen (16.2%) est tres rapproche de ceux d'etudes anterieures semblables, pour des valeurs du meme ordre. On pense que la variation interlaboratoires resultant de cette etude s'explique par les methodes de dosage utilisees plutot que par les procedes d'extraction et de purification. La methode de dosage Webb-McCall a donne des resultats plus exacts et plus precis que les autres methodes utilisees.

066578
LEE J * **Complexation analysis of fresh waters by equilibrium diafiltration** * Water Res * 17(5) 501-510 * 1983.

Equilibrium ultrafiltrations has been employed to determine the extent of Cu, Ni, Co, Fe, Mn and Zu chelation in oxic waters from mineralized terrains. Concentrations of Cu, Ni and Co were determined in different organic fractions separated by various Amicon ultrafilters. Titrations of fresh water samples with metal ions were made, and "free" metal concentration measured by equilibrium diafiltration. Experiments were made at concentrations and pH at which metals and ligands occur in natural waters. Conditional stability functions ranged from 10 sup 6.72 at pH 6.5 to 10 sup 7.07 at pH 7.6 for Ni and 10 sup 6.85 at pH 6.8 to 10 sup 6.97 at pH 7.6 for Co. At low metal concentrations (approximately 8 X 10 to the power of minus 7 M) only one complexing class of major importance for natural environments was observed. The order of metal complexing ability was found to be Cu greater than Ni greater than Co greater than Zn greater than Mn with Cu showing a preference towards the higher MW organic fractions.

066380
LEE RF, RYAN C * **Microbial and photochemical degradation of polycyclic aromatic hydrocarbons in estuarine waters and sediment** , IN: Conf on Pollution in the North Atlantic Ocean, Halifax, NS, Oct 19-23, 1981 * Can J Fish Aquat Sci * 40(suppl 2) 86-94 * 1983.

Radiolabeled polycyclic aromatic hydrocarbons (PAH) containing up to three rings, including naphthalene, methylnaphthalenes, and phenanthrene, were degraded (measured by 14CO2 production) in

water samples from both Narragansett Bay and southeastern United States. Higher weight PAH, including benz(a)anthracene, chrysene, fluorene, and anthracene, showed little, if any, degradation in water but were readily degraded when added to sediment-water slurries. In areas with low levels of petroleum in the water or sediment there was a lag before appreciable degradation began, and the rate of degradation fitted a first-order equation. Half-lives, calculated for the various PAH added to water or sediment-water slurries, were very low during winter months; (14C)methylnaphthalene added to water from Skidaway River, Georgia, in January (8C) was 57 d, while in September (28C) it was 3 d.

F11714
LEGENDRE P, CHODOROWSKI A, PICHET P, POTVIN P * **Qualite des eaux, interpretation des donnees lacustres (1971-1977)** * 409p * Minist environ du Que, Serv qualite des eaux * 1980-04.

Ce rapport constitue une premiere synthese des donnees cumulees de qualite des eaux lacustres sur le territoire du Quebec meridional. Dans un premier temps, l'image des donnees disponibles est degagee par la validation de celles-ci et leur description statistique. Ensuite la variabilite spatiale est examinee sur la base d'une interpretation des huit regions a l'etude a l'aide d'une serie de descripteurs physico-chimiques et atmospheriques. Sous l'aspect principal de la mineralisation, les valeurs extremes des parametres physico-chimiques sont examinees, mettant en evidence certains problemes d'actualite tels que l'acidification du milieu lacustre. Le rapport presente egalement une esquisse des principales associations de poissons du Quebec sur le territoire considere et tente de degager l'evolution temporelle de la qualite de l'eau pour une serie de lacs. Il se termine sur une suite de recommandations reliees a l'acquisition future de donnees.

066855
LEGGATT E, VEAL D * **Chlorination assessment procedures** * 14p * Ont Minist Environ * 1981.

Receiving water chlorination assessment techniques presented in this report describe the methods commonly in use within the Ontario Ministry of the Environment. Operational considerations with chlorinated effluents, problems with the use of chlorine, chlorine toxicity, and the effects of chlorine, are detailed. Assessment techniques include a description of analytical methods, sample collection, field survey procedures for rivers and lakes, prediction techniques for rivers including a one-dimensional model and mixing zone models, and prediction techniques for lakes. Alternatives to chlorination still in the developmental stage, are also discussed.

F11966
LEMIEUX R * **Le dossier noir des neiges usees** * Que sci * 22(7) 48-51 * Presses de l'Univ Quebec * 1984-03.

Dans les 9 millions de metres cubes de neige ramasses chaque annee a Montreal, la firme Pluram a calcule qu'on y trouvait des quantites astronomiques de contaminants: 100 000 tonnes metriques de sel, 23 400 tonnes de solides en suspension, 29 tonnes de plomb, 232 tonnes d'huiles et de graisses, puis, finalement, une tonne de metaux lourds tels que le baryum, le zinc, le cuivre, le chrome et l'arsenic. Et 27% de tout cela est rejete dans le fleuve. Pas besoin d'autorisation: le Quebec n'a ni reglement, ni directive. Le rejet de cette neige, avec tous ses contaminants et ses ordures, risque de derouter les especes aquatiques dans leur migration et leur mode de reproduction.

062237
LEPPARD GG * **Trace element speciation and the quality of surface waters: an introduction to the scope for research, Chapter 1** , IN: Trace element speciation in surface waters and its ecological implications, NATO Workshop 9, Nervi (GENOA), IT, 1981 * LEPPARD GG * 15p * Plenum, New York, NY US * (1982).

This paper introduces the 3 day Workshop. Subjects covered were: analytical approaches to the problem of trace element speciation; trace element species and general aspects of their interactions with aquatic life; and new perspectives and future actions. Tables in this paper list 7 problem oriented research topics, and 5 methodology oriented topics, endorsed by the Workshop. Highlights of the discussions are outlined. Appendix 1 lists the principal speakers and discussants. Appendix 2 outlines a guideline for setting research priorities on trace elements in natural waters. A new focus is being imposed on ecological impact studies, that of determining which active trace element species merit the most intensive research from the standpoint of environmental perturbation. The major thrust should be directed towards the development of chemical speciation schemes which can be related directly to measures of bioavailability.

F10748
LEVINGS CD * **Les consequences ecologiques du dragage et de l'elimination des residus du dragage dans les eaux canadiennes** * CNRC no 18131 * 150p * Cons natl rech Can, Ottawa, Ont * 1983.

Cette publication, preparee pour le Sous-comite de l'eau du Comite associe du CNRC sur les criteres scientifiques concernant l'etat de l'environnement resume les connaissances actuelles des effets ecologiques de dragage et de deversement sur les ecosystemes aquatiques du Canada. En 1979, on a deverse 19.6 millions de metres cubes de matieres draguees dans les

eaux cotieres du pays. Entre 1975 et 1979, 2.5 millions de metres cubes de ces matieres ont ete deversees dans les secteurs canadiens des Grands Lacs. La consequence principale du dragage au Canada est la perturbation physique des ecosystemes. Bien qu'il y ait des operations de dragage a une echelle relativement petite, celles de grande portee (par exemple le dragage par aspiration des rivieres ou la construction des iles artificielles) provoquent un dereglement considerable au sein de l'ecosysteme. Les habitats sensibles, tels que les frayeres de saumons, peuvent etre serieusement perturbes meme par des operations de peu d'envergure. Lorsque les sediments renfermant des metaux lourds, des composes organiques et des dechets de bois, sont enleves par le dragage et deverses ailleurs, on craint que la liberation de telles substances puisse avoir un effet nefaste sur la flore et la faune avoisinantes. Malgre beaucoup de recherches au Canada et a l'etranger, l'on ne comprend pas encore tres bien le mouvement et la biodisponibilite des composes chimiques liberes de ces sediments. Dans ce rapport figurent des chapitres sur les effets physiques, chimiques et ecologiques du dragage. L'on decrit plusieurs sortes d'operations de dragage et deversement et presente des recommandations quant aux recherches importantes a mener afin de resoudre des problemes d'une importance particuliere pour le Canada.

063966
LIU D, CAREY J, THOMSON K * **Fulvic-acid-enhanced biodegradation of aquatic contaminants** * Bull Environ Contam Toxic * 31(2) 203-207 * 1983-08.

This paper examines how naturally occurring fulvic acid can enhance the biodegradation of synthetic organics. It is speculated that this enhanced biodegradation may help play an important role in determining the fate of aquatic contaminants. Two potential mechanisms for the observed enhancement are mentioned: ability of fulvic acid to catalyze extra cellular electron transport or function as a terminal electron acceptor; permeability of cell walls to certain substances can be increased by fulvic acid. The study's results show that naturally occurring humic substances can enhance the biodegradation of aquatic contaminants but the mechanism of this enhancement and its environmental significance needs further investigation.

066535
LUCOTTE M, D'ANGLEJAN B * **Forms of phosphorus and phosphorus-iron relationships in the suspended matter of the St Lawrence Estuary** * Can J Earth Sci * 20(12) 1880-1890 * 1983-12.

The partition of phosphorus between the organic fraction (P sub ORG) and both the detrital (apatite rich) and non-detrital (adsorbed) fractions (P sub AP and P sub CDB) was studied in the particulate matter of the St. Lawrence Estuary and two of its tributaries. The adsorption of the P sub CDB fraction on particulate iron was examined. P sub ORG makes up about one third of the total particulate P, which ranges between 44 and 64 micro g. at./g. Everywhere in the estuary, and regardless of salinity, the concentration of P sub AP represents twice that of P sub CDB. The hydroxide fraction (Fe sub CDB) is on the average 25 and 29% of the total particulate iron in May and September, respectively, but is much higher in the tributaries. The atom ratio Fe/P sub CDB of hydroxide Fe to adsorbed P fluctuates around 16 for May and 19 for September. Low values (13-16) are characteristic of the turbidity maximum, whereas higher ones are found in the deeper, more saline waters (16-26) and in the tributaries (17-26). Although any iron precipitation in the low-salinity turbid zone is masked by sediment resuspension, the low values of the ratio there suggest some P uptake on Fe-rich particles. Dissolved phosphate being conservative with respect to the salinity desorption does not take place, or is only minor seaward of the turbidy maximum.

062397
LUM-SHUE-CHAN KR * **Dissolved and particulate trace metals in meltwater from the Rhone glacier** * Schweiz Z Hydrol * 43(2) 286-295 * 1981.

Glacial meltwater and sediment at the source of the River Rhone have been analyzed to determine: 1. The partitioning of Al, Cd, Co, Cu, Cr, Fe, Mn, Ni, Pb and Zn between the water and particulate phase, 2. The particle size ranges which affect the dissolved trace metal ion composition of the meltwater and 3. The availability (potential release) of the ten trace metal ions from the sediment. Greater than 80% of the total Cd, Cu, Mn, Ni and Zn were found to be in operationally-defined (0.4 micro m) dissolved forms. Fe and Al in the meltwater are primarily associated with particles in the size range 0.4-8 micro m, while Cd, Cu, Mn, Ni and Zn occur with particles smaller than 0.1 micro m. For the sediment, Cu, Ni and Pb were significantly present as exchangeable forms; only Cu, Ni, Pb and Zn were determined as organically-bound forms.

064066
MACKAY D, JOY M, PATERSON S * **A quantitative water, air, sediment interaction (QWASI) fugacity model for describing the fate of chemicals in lakes** * Chemosphere * 12(7,8) 981-997 * 1983.

A mathematical model is developed and illustrated which describes the fate of a chemical in a lake system consisting of water, bottom and suspended sediments, and air. Equilibrium is quantified using the fugacity

concept and fugacity capacities. Expressions are written in the form of fugacity equations with a common D parameter, or kinetic coefficient, for processes of advective flow, volatilization, sediment resuspension, deposition and burial, wet and dry atmospheric deposition, and degrading reactions. It is suggested that by describing these diverse processes by identical mathematical expressions, their relative rates are more easily compared and algebraic manipulation is facilitated. Steady and unsteady state solutions of the equations are presented and illustrated for systems involving contamination of lakes.

065473
MACKIE GL, ROOKE JB, ROFF JC,GERRATH JF * **Effects of changes in discharge level on temperature and oxygen regimes in a new reservoir and downstream** * Hydrobiologia * 101(3) 179-188 * 1983-05-06.

Temperature and oxygen regimes were monitored weekly in a four-year old reservoir and downstream for ten weeks during the summer (May 15 to July 30, 1979), and monthly in the fall and winter. During the summer discharge levels were changed from top to bottom in the eighth week, back to top in the ninth, all at 0.71 cu m/s(= 25cfs), and returned to the bottom in the tenth, but at 1.14 cu m/s(= 40 cfs). Changing the discharge level had little or no impact on the thermal regime within the lake or downstream at 1.14 cu m/s and only a moderate impact on water in the lake near the dam at 0.71 cu m/s bottom discharge by generating double thermoclines. Oxygen depletion rates were greatest near the surface of the lake, mainly due to temperature effects, but increased greatly at the 3 m depth, the level of the top discharge port, when discharge was changed from bottom to top. Discharge of anoxic waters through the bottom of the dam caused a drop in oxygen content immediately downstream but oxygen content returned to inflow values within 1 km downstream of the dam.

065098
MACLAREN PLANSEARCH *

Cold Lake - Beaver River regional water resources study: water quality component * vp * MacLaren Plansearch, Guardian Build, Suite 608, 10240 - 24th ST, Edmonton, Alta T5N 3W6 * 1982-09.

This study describes the existing water quality of the streams in the Beaver River basin and the mechanisms affecting them and predicts the change in basin water quality which would result from the proposed industrialization of the basin. The stream quality model, Qual-II, is used to describe the existing water quality and to predict future changes in the streams within the prescribed study area of the Beaver River basin. The model was calibrated using data collected during a 1981 sampling survey by Alberta Environment. A second data set, also collected in 1981, during a lower flow period, was used to verify the accuracy of the calibrated model. Variance between the prediction of the calibrated model and the second survey data were noted. Four model runs were carried out to predict the effects of industrialization and the accompanying population increase upon teh water quality of the basin, using low flow conditions generated from historical data and a development scenario to teh year 2000 A.D. Results of these runs indicated that current water quality criteria would be exceeded for un-ionized ammonia, chloride, sodium, sulphate, and phenol.

066652
MAGUIRE RJ * **Analysis, occurrence and fate of organotin compounds in the environment** * NWRI Manuscr Rep No 83-25 * 46p * Environ Can, Natl Water Res Inst, Inland Waters Dir * 1983-12.

A review is presented of the analysis, occurrence and fate of organotin compounds in the environment. The state of the art in analytical instrumentation is generally adequate, although there are few published methods on media other than water. The main classes of organotin compounds likely to be found in the Canadian environment are methyl-, butyl-, phenyl- and cyclohexyltin compounds, and most of these species can be analyzed satisfactorily using existing methods; however, it is desirable to have a method which features continuous introduction of high pressure liquid chromatographic eluent into a suitable detector for those compounds, or conjugates, which are not volatile. There are few data on the occurrence of organotin compounds in the environment. Some of those that have been detected are very toxic to aquatic organisms. Persistence studies on the major classes of organotin compounds have indicated that abiotic degradation generally occurs, as does biological degradation, through mechanisms of sequential dealkylation or dearylation. Adsorption to soils and sediments appears to be strong, although subsequent mobilization by biota cannot be ruled out. In general, photolysis appears to be the rate-limiting degradative step. Methylation of tin and organotins, although a slow process, may nevertheless be significant with regard to transport of tin in and from aquatic environments. Further information on occurrence, persistence and fate of methyl-, butyl-, phenyl- and cyclohexyltin species is required before environmental and human health risk assessments can be made.

062380
MAGUIRE RJ, CHAU YK, BENGERT GA, HALE EJ, WONG PTS, KRAMAR O * **Occurrence of organotin compounds in Ontario lakes and rivers** *

Environ Sci Technol * 16(10) 698-7-2 * 1982-10.

The presence of butyltin and methyltin species is reported for the first time in lakes, rivers, and harbors in Ontario. Concentrations of tri-n-butylin in Collingwood Harbor, a marina in Lake St. Clair, Toronto Harbor, and Ramsey Lake are 15-60% of the LC100(sup 12d) value for a sensitive aquatic species, rainbow trout yolk sac fry. The species Bu3Sn+, Bu2Sn2+, and inorganic tin are concentrated by factors of up to 10,000 in the surface microlayer relative to subsurface water. Concentrations of methyltin and dimethyltin are high in Kingston Harbor and Whitby Harbor and in industrial areas such as Lake St. Clair.

063642
MAGUIRE RJ, KUNTZ KW, HALE EJ * **Chlorinated hydrocarbons in the surface microlayer of the Niagara River** * J Great Lakes Res * 9(2) 281-286 * 1983.

Concentrations of 18 chlorinated hydrocarbons were determined in the surface microlayer, subsurface water, and suspended solids at five stations along the length of the Niagara River in July 1981. The concentration of heptachlor epoxide in the unfiltered surface microlayer was greater than that in unfiltered subsurface water at all five stations by factors of 138 to 225; alpha-endosulfan and "total PCB" were similarly enriched in the surface microlayer at two stations each, by factors of up to 203 and 32, respectively. In addition, mass balances for the 18 compounds in the three "compartments" sampled showed that (i) at three stations there was more heptachlor epoxide in the unfiltered surface microlayer than associated with those suspended solids which were collected with a continuous flow separator from a depth of 1 to 2 m, and (ii) there was far more alpha- and gamma-BHC, dieldrin, and "total PCB" present in unfiltered subsurface water than associated with the suspended solids. This latter finding in particular necessitates a revision of earlier estimates of loading of at least some chlorinated hydrocarbons to Lake Ontario from the Niagara River, based solely on concentrations in the suspended solids fraction sampled with the same continuous flow separator.

066365
MAKAY WC (ED) * **Proceedings of the Ninth Annual Aquatic Toxicity Workshop: November 1-5, 1982, Edmonton, Alberta** * Can Tech Rep Fish Aquat Sci 1163 * 225p * Dep Fish Oceans, Fish Habitat Manage Branch, Ottawa, Ont * 1983-11.

Aquatic Toxicity Workshops have been held annually since 1974 when the first session was hosted by the Freshwater Institute in Winnipeg. The Workshop has provided a forum for discussion and information exchange in the disciplines composing the field of aquatic toxicology. It has been the intent of the National Steering Committee and the individual Workshop Committees, at the request of the delegates, to keep the Workshop atmosphere informal. Provision of ample opportunities to discuss relevant issues in aquatic toxicology with colleagues from government agencies, industry, consultants and universities has been as important to the organizers as the sessions themselves. These objectives were clearly accomplished at the Ninth Annual Workshop.

062817
MAKI JS, SIERSZEN ME, REMSEN CC * **Measurements of dissolved adenosine triphosphate in Lake Michigan** * Can J Fish Aquat Sci * 40(4) 542-547 * 1983-04.

Comparisons of two methods of separating dissolved adenosine triphosphate (dATP) were made, both in the laboratory and in vertical profiles in Lake Michigan. Laboratory work indicated that filtration through a 0.2 micro m pore filter or centrifugation of samples gave similar concentrations of dATP. In Lake Michigan, however, the filtration method gave significantly higher dATP concentrations suggesting some adverse filtration effect. Therefore, centrifugation was chosen as the method to determine dATP. Resulting particulate ATP (pATP) concentrations indicated the highest levels of microbial biomass were located below the epilimnion. Feeding by Mysis relicta appeared to decrease pATP but not release much dATP.

064139
MALLANDAINE AI * **The effect of land uses on lake water quality, Sturgeon Lake, Alberta** * 247p * Dep Geogr, Univ Alberta, Edmonton, Alta * 1980.

This study was conducted in the Sturgeon Lake drainage basin. The objectives were to increase the water quality data base and to relate the findings to land uses in the watershed. This would improve the reliability of management plans for the lake area. A resource inventory of the watershed components was compiled and correlated with water quality data collected from a dozen sample sites over a three month period. It was found that the lake is naturally mildly eutrophic with most of the nutrient inputs coming from natural sources. Primary productivity in the lake was found to be limited by physical factors such as color, turbidity and self-shading rather than nutrient availability. Lake levels are maintained at an excessively high level in order to maintain a water supply for the town of Valleyview. As a result, good beach areas are flooded for most of the year and many shorelines are being eroded. Alternate means of supplying water to the town are suggested. Development capacity calculations indicate that the lake is near the optimum level of

development, however possible areas for some development are recommended. Recommendations are also made regarding wetland drainage and lake restoration techniques. Possible subject areas meriting further study are suggested.

063062
MANITOBA, CLEAN ENVIRON COMM * **Report on a proposal for the classification of Manitoba's surface water, Grass - Burntwood Rivers Principle Watershed Division** (see chapter 4.16.2 for complete reference - voir chapitre 4.16.2 pour la reference complete)

064894
MANNY BA, OWENS RW * **Additions of nutrients and major ions by the atmosphere and tributaries to nearshore waters of northwestern Lake Huron** * J Great Lakes Res * 9(3) 403-420 * 1983.

Nutrient additions by the atmosphere and six tributaries to nearshore waters of northwestern Lake Huron were measured at weekly intervals from August 1975 to July 1976. The atmosphere contributed 43% of the nitrogen (N) and 10% of the phosphorus (P) that was added during the year. The 1975-76 atmospheric loading rate of total N to this area (11 kg/ha/yr) was one of the highest found to date in the United States. N was conserved more efficiently than P in the tributary drainage basins. Of the N and P that fell annually on the watersheds under study, 2 to 37% of the N and 31 to 84% of the P was carried with runoff to the lake. From a basin where ditching and clearcutting occurred, water, P, silica (SiO2), N, and sodium were lost at higher rates than from five other basins. Most of the N in bulk atmospheric samples (23%) and tributary waters (56%) was dissolved organic N, a form of N not often measured.

066654
MARSALEK J, GRECK B * **Toxic substances in urban land runoff in the Niagara River area** * NWRI Manuscr Rep No 83-17 * vp * Environ Can, Natl Water Res Inst, Inland Waters Dir * 1983-09.

Frequencies, concentrations, and annual loadings of 51 selected persistent toxic substances in urban runoff have been studied in the Niagara area. Toward this end, samples of urban runoff and sediment have been collected at 15 sites in Fort Erie, Niagara Falls, and Welland. The collected samples have been analyzed for polychlorinated biphenyls, organochlorine pesticides, polyaromatic hydrocarbons, chlorinated benzenes, and trace elements. For each substance studied, frequencies of occurrence and mean event concentrations have been determined. Using such data and the calculated annual runoff volumes and sediment yields, estimates of annual loadings of toxics transported by urban runoff and sediment have been produced for the Niagara area.

064220
MAYHOOD DW * **Chemical and biological monitoring of Muskeg drainage at the Alsands project site, Program evaluation and suggestions for continued monitoring (Draft)** (see chapter 4.9 for complete reference - voir chapitre 4.9 pour la reference complete)

064222
MAYHOOD DW, WALDER GL, DICKSON T, GREEN RB, REID DE, STUSHNOFF R * **Chemical and biological monitoring of Muskeg drainage at the Alsands project site, Volume II, Monitoring and fish studies** (see chapter 4.9 for complete reference - voir chapitre 4.9 pour la reference complete)

062857
MCBEAN EA, BISHOP R, ASHAMALLA A, AHMED M * **Mathematical modeling of coliforms in combined sewer discharges** , IN: Proc of Stormwater and Water Quality Management Modeling Users Group Meeting, 18-19 October, 1982 * WISNER PE * 186-202 * IMPSWM, Univ Ottawa, Dep Civ Eng, Ottawa, ONt K1A 9B4 * 1983-04.

A technique considering the sanitary sewer flow and storm sewer flow components is shown to have merit for the estimation of coliform loadings arising from combined sewer overflows. Difficulties in selecting appropriate storms and their resulting mass loadings of coliforms in assessing the quality of the receiving water bodies, are discussed. A methodology for assessment and a calibration/verification procedure to examine the relative merits of this procedure, are seen as necessary. Water quality data from four storms using samples collected by the City of Edmonton, Alberta, are presented to examine total mass loading of coliforms and the temporal variation of concentrations within a storm. The temporal variations are considered in greater detail by examination of the June 21, 1979 storm at Rat Creek whereby measured concentrations are constructed from dry weather flow and stormwater flow. A characteristic U-shape of observed concentration vs time curve for a storm is reproduced. It is concluded that this shape bears careful consideration in control measures design.

062002
MCCORQUODALE JA, IMAH EH, BEWTRA JK, HAMDY YS, KINKEAD JK * **Transport of pollutants in natural streams** * Can J Civ Eng * 10(1) 9-17 * 1983-03.

A modified two-dimensional mathematical model has been developed to simulate the dispersion of soluble degradable and nondegradable pollutants discharged from

multiple industrial outfalls along a large river. This model takes into account the effects of depth and velocity variations in both longitudinal and lateral directions, the removal rates of degradable organic trace pollutants, the lateral convection of mass, and the effect of jet mixing and dilution at the outfalls. It can also accommodate the rapid convergence or divergence in stream width and the influence of an island and of flow diversion on pollutant dispersion. The model was validated by using phenol as a pollutant and comparing the computed values with the field data collected by the Ontario Ministry of the Environment. The application of this model to the simulation of organic pollutant levels in the St. Clair River due to discharges from multiple sources is demonstrated in this paper.

066098
MCCORQUODALE JA, IMAM EH, BEWTRA JK, HAMDY YS, KINKEAD JD * **Simulation and control of degradable organic pollutant levels in St. Clair River** , IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * v2 603-619 * Can Soc Civ Eng * (1981).

A modified two-dimensional mathematical model has been developed to simulate the dispersion of soluble non-conservative and conservative pollutants discharged from multiple industrial outfalls along the St. Clair River. This model takes into account the effect of depth and velocity variations in both longitudinal and lateral directions, the removal rates of degradable trace organic pollutants, lateral convection of mass, and the effect of jet mixing and dilution at the outfalls. It can also accommodate rapid convergence or divergence in stream width, influence of the presence of an island and the effect of flow diversion. The model was validated by using phenol as a pollutant and comparing the computed values with the field data collected by the Ontario Ministry of the Environment. The application of this model in simulating the organic pollutant levels in St. Clair River due to discharges from multiple sources has been demonstrated in this paper.

064376
MCCOY GA * **Nutrient limitation in two arctic lakes, Alaska** * Can J Fish Aquat Sci * 40(8) 1195-1202 * 1983-08.

Batch-culture algal bioassays of Selenastrum capricornutum were used to predict the limiting nutrient in two small arctic-tundra lakes in 1979. In 1980 bioassays were performed again, and fertilizer was added to the lakes to test the predictions made from the 1979 biossay results. In 1980, after the addition of phosphorus fertilizer, phytoplankton standing crop increased approximately 10-fold. After the addition of nitrogen fertilizer, another 10-fold increase in phytoplankton growth was measured. Concurrently, maximum daytime dissolved oxygen increased from 100 to 150% saturation, and pH increased from 7.0 to about 9.2. Further additions of fertilizer in late August and early September 1980 caused no significant increase in primary production. If the nitrogen content of the lake water is increased but that of phosphorus is not, no increase in algal growth occurs. Growth increases with phosphorus additions, but the magnitude of this increase is determined by the available nitrogen. When additional nitrogen is supplied to the system, further increases in algal growth occur. When nitrogen and phosphorus are supplied in excess, physical factors such as light or temperature become limiting in the lakes.

062851
MCCREA RC, MERRIMAN JC * **Water quality in the Moose River - a pilot study, 1977 - 1978** * Rep Ser No 70 * 9p * Environ Can, Inland Waters Dir, Ont Reg, Water Qual Branch, Burlington, Ont * 1981.

The Moose River Pilot Study was carried out near the mouth of the Moose Rvier to examine the temporal, lateral and seasonal variability in the water chemistry and to design a baseline water quality sampling program to determine seasonal variation and future long-term trends. In all, eight surveys were conducted between March 1977 and March 1978. Water samples were collected from four locations across the Moose River and were analyzed for major ions, nutrients and trace metals. The results indicated that short-term variations in the water chemistry were not significant and that the Moose River was highly channelized. Many parameter concentrations (especially major ions) showed strong seasonal dependence. Futhermore, it was concluded that baseline water quality conditions would be evaluated better if future sampling were carried out on a biweekly (14-day intervals) basis in the midstream channels.

065442
MCLEOD AI, HIPEL KW, COMANCHO F * **Trend assessment of water quality time series** * Water Resour Bull * 19(4) 537-547 * 1983-08.

A general methodology is described for identifying and statistically modeling trends which may be contained in a water quality time series. A range of useful exploratory data analysis tools are suggested for discovering important patterns and statistical characteristics of the data such as trends caused by external interventions. To estimate the entries in an evenly spaced time series when data are available at irregular time intervals, a new procedure based upon seasonal adjustment is described. Intervention analysis stage to rigorously model changes in the mean levels of a series which are identified using exploratory data analysis

techniques. Furthermore, intervention analysis can be utilized for estimating missing observations when they are not too numerous. The effects of cutting down a forest upon various water quality variables and also the consequences of acid rain upon the alkalinity in a stream provide illustrative applications which demonstrate the effectiveness of the methodology.

066574
MCQUEEN DJ, LEAN DRS * **Hypolimnetic aeration and dissolved gas concentrations, enclosure experiments** * Water Res * 17(12) 1781-1790 * 1983.

Two large circular enclosures, each containing approx. 550 cu m of water, 14 m deep, and open to the mud-water interface, were used to monitor the effects of hypolimnetic aeration. One enclosure was held as a control, the other aerated every 3 or 4 days for a period long enough (usually less than 2 h) to maintain hypolimnetic O2 levels at greater than 4 mg per l. Nutrient additions (10 g of 90% H3PO4 and 250 g NaNO3 per week) to each enclosure were controlled from the commencement of the experiment (17 June 1980) until its completion (2 November 1981). Temperatures in both enclosures were identical. Hypolimnetic O2 levels in the control fell to zero during both summers, but remained at greater than 4 mg per l in the aerated enclosure. Free N2 concentrations in the hypolimnion of the aerated enclosure was higher than in the control. Concentrations of H2S in the control hypolimnion increased to greater than 5 mg per l and concentrations of CH4 increased to greater than 18 mg per l. Both remained at or near zero in the aerated enclosure. Tests of aerator efficiency suggested that the full air-lift design that was employed had an average O2 exchange efficiency of 42% which is higher than the values reported for most other designs.

063395
MERRIMAN JC, MCCREA RC * **Ottawa River water quality, National Capital region, 1978** * Sci Ser No 132 * 14p * Environ Can, Inland Waters Dir, Ont Reg, Water Qual Branch, Burlington, Ont * 1982.

In 1978 water quality conditions in the National Capital Region were studied to determine the water quality of the Ottawa River before sewage treatment measures were completed in nearby Quebec municipalities. Several parameters showed spatial variation with significant increases across transects as well as significant downstream increases in concentration. These increases were caused by tributary inputs and municipal and industrial discharges. Total phosphorus exceeded the recommended surface water guideline more than 60% of the time at the downstream transect. Fecal coliform exceeded the recommended guideline for contact recreation 90% of the time in the study area.

062401
MERRIMAN JC, MOULTON RJ, BERANEK P, SHAW JR * **Water resources of the Hudson Bay lowland: a literature review and annotated bibliography** * Inf Rep O-X-338 * 43p * Great Lakes Res Cent, Can For Serv, Dep Environ, Sault Ste Marie, Ont * 1982.

This report is divided into three sections: 1) a literature review which includes descriptions of studies carried out in water quality, water quantity, and oceanography, as well as summaries of data available in these areas and an assessment of data gaps and research needs; 2) an annotated bibliography with keywords and work location, arranged in alphabetical order by author; and 3) a keyword index listing publications by subject.

F10612
MESSIER D * **Mesures de la salinite et des niveaux de l'eau dans la riviere Koksoak en 1981** * 33p * Soc energie de la Baie James, Groupe d'etude conjoint Caniapiscau-Koksoak, Montreal, Que * 1982-11.

Dans le cadre de l'amenagement du complexe hydroelectrique La Grande, les eaux du bassin superieur de la riviere Caniapiscau ont ete detournees en octobre 1981. Des lors, les caracteristiques des eaux de la riviere Koksoak situee a l'aval des ouvrages de detournement, sont inevitablement modifiees par l'extension de l'intrusion des eaux salees en provenance de la baie d'Ungava. En mai et en juillet 1982, ont ete effectuees deux campagnes de mesures de la salinite de la riviere Koksoak sous diverses conditions de debit. Les mesures des niveaux d'eau, des debits d'eau douce, de la distribution de la salinite de surface et des variations de la salinite en fonction de la maree font l'objet de ce rapport.

063478
MILES JRW, HARRIS CR, MORROW DC * **Assessment of hazards associated with pesticide container disposal and of rinsing procedures as a means of enabling disposal of pesticide containers in sanitary landfills** * J Environ Sci Health Part B * B18(3) 305-315 * 1983.

To study problems associated with pesticide container disposal, a small vegetable production area in southwestern Ontario, the Thedford Marsh, was selected as the site for a model study. A container collection system was organized during the 1981 growing season, with collections being made from the ca. 50 growers on the marsh twice each month. In addition to the regular collection program a cleanup service for empty pesticide containers stored on farms or discarded on public lands also was initiated. More than 3600 containers were collected and disposed of at an authorized landfill site. Ca. 2/3 were

herbicide containers, ca. 1/4 were insecticide containers, and 3% were fungicide containers. Unrinsed containers contained as much as 5 1/2% of the original contents with an average of 1%. Containers rinsed by the triple rinse method or using rinsing devices (E-Z Rinse, JET Rinse) generally contained less than 0.1% of the original content. Some formulations presented rinsing problems due to settling and caking. The results indicated that, while unacceptable quantities of pesticide residues remain in unrinsed containers, most rinsed pesticide containers will be acceptable for disposal at municipal sanitary landfill sites.

065928
MINER JR * **Cattle feedlot microbiology, an overview** (see chapter 8 for complete reference - voir chapitre 8 pour la reference complete)

062241
MONTGOMERY RH, LEE VD, RECKHOW KH * **Predicting variability in a Lake Ontario phosphorus model** * J Great Lakes Res * 9(1) 74-82 * 1983.

The prediction of a model always has a degree of uncertainty. Because the level of uncertainty is inversely related to the value of information contained in the prediction, there is a need to quantify the uncertainty. One approach to estimate prediction uncertainty is first-order error analysis. In this method, the error in a characteristic (variable or parameter) is defined by its first nonzero moment (the variance). Errors are propagated through the model using first-order terms in the Taylor series, and the variances are then combined to yield the total prediction uncertainty. An alternative approach to model prediction error analysis is Monte Carlo simulation. In this technique, probability density functions are assigned to each characteristic (variable or parameter), reflecting the uncertainty in that characteristic. Then, values are randomly selected from the distribution for each term and inserted into the model, to calculate a prediction. Repeating this process a number of times produces a distribution of predicted values, which reflects the combined uncertainties. These two approaches (first-order error analysis and Monte Carlo simulation) are applied to Lake Ontario data using a steady state mass balance phosphorus model. Comparisons are made which suggest guidelines for the use of each.

066724
MONTREAL ENG CO LTD * **Final report, Southwestern Nova Scotia water supply requirements and development feasibility, Phase II Southwestern Nova Scotia Water Resources Evaluation Project** (see chapter 4.11 for complete reference - voir chapitre 4.11 pour la reference complete)

F10217
MUDROCH A * **Etude de certains marais cotiers selectionnes des Grands lacs** (see chapter 4.9 for complete reference - voir chapitre 4.9 pour la reference complete)

063629
MUDROCH A * **Distribution of major elements and metals in sediment cores from the western basin of Lake Ontario** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

062332
MUDROCH A, ZEMAN AJ, KALAS LL * **Calcium carbonate in postglacial Lake Erie sediment** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

066513
MUNICIP ENG BRANCH, POLLUT CONTROL DIV, ENVIRON PROT SERV, ALTA ENVIRON * **1981 Summary of water chemical analysis, Red Deer region** * 179p * Alta Environ, Pollut Control Div * 1982-06.

This report summarizes the chemical analyses performed by the Alberta Environmental Laboratory on water from municipal waterworks in the Red Deer Region during 1981. Water samples were submitted from cities, towns, villages and hamlets which have water distribution systems, and communities from Municipal Districts, Counties, Improvement Districts and Special Areas which have a community well or a common watering point. Also listed are results from trailer parks, estates and provincial parks that had their community water analyzed.

062055
MURPHY TP, HALL KJ, YESAKI I * **Coprecipitation of phosphate with calcite in a naturally eutrophic lake** * Limnol Oceanogr * 28(1) 58-69 * 1983-01.

Phosphorus-rich deposits of Eocene volcanic rock have caused some lakes in the interior of British Columbia to become eutrophic without direct human influence. In Black Lake the soluble reactive phosphorus (SRP) usually exceeds 250 micro g P per liter. When calcite precipitation occurred during blooms of Aphanizomenon, SRP was completely removed from the photic zone. In blooms with no calcite formation, SRP changed little. These observations were replicated by splitting the lake with a curtain. Calcite precipitation was also observed several times in four large enclosures (limnocorrals). The subsequent disappearance of phosphate was correlated with an increase in pH and a reduction of Ca and alkalinity and not necessarily with primary production or algal biomass.

063207
NATL RES COUNC CAN, ASSOC COMM SCI CRITERIA ENVIRON QUAL, SUBCOMM ON WATER * **Radioactivity in the Canadian aquatic environment** * NRCC No 19250 * 292p * Natl Res Counc Can, Assoc Comm Sci Criteria Environ Qual, Ottawa, Ont K1A OR6 * 1983.

The results of a comprehensive critical review was conducted of literature relating to the effects of ionizing radiation on aquatic organisms and ecosystems in order to formulate recommendations for further research in this area, and to determine critical levels are given. Emphasis is placed on natural and anthropogenic sources of radionuclides in the aquatic environment: transport, distribution, and behavior of radionuclides in freshwater, marine, and estuarine systems; dosimetry of ionizing radiation in the aquatic environment; and effects of ionizing radiation on aquatic organisms, populations, and ecosystems. One of the largest sources of man-made radionuclides in the aquatic environment is the atmospheric testing of nuclear weapons. The transport, distribution and behavior of radionuclides are discussed in the context of global and national hydrologic cycles and their nature is discussed in detail. Two methods of calculating dose rates to aquatic organisms are described: the Oak Ridge National Laboratory Method and the IAEA Method. Findings of reports on radiation effects on aquatic organisms due to chronic, low-level exposure; an evaluation of the effects of chronic, low-level irradiation on aquatic populations and ecosystems; and a summary of the studies on natural populations of aquatic organisms exposed to chronic, low-level irradiation are included. Information available and previous reviews on mutation rates in fish are summarized. A comprehensive bibliography is included.

066141
NEAME PA, DEAN JR, ZYTARUK BG * **Distribution and concentrations of naturally-occurring radionuclides in sediments in a uranium mining area of northern Saskatchewan, Canada** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

062850
NEILSON MA * **Trace metals in Lake Ontario, 1979** * Sci Ser No 133 * 13p * Environ Can, Inland Waters Dir, Ont Reg, Water Qual Branch, Burlington, Ont * 1983.

During 1979, three cruises were conducted on Lake Ontario to measure total trace metal concentration on the open lake. With the exception of five isolated incidents (two for cadmium and three for iron), the lake was found to be in compliance with the objectives of the 1978 Water Quality Agreement. Nearshore values were found to be higher than those of the open waters, with metal concentrations generally greater at the western end of the lake. To define this spatial variation, a statistical procedure was used to divide Lake Ontario into zones for each of the individual trace metals. A composite map was compiled from this information. For each metal, on a cruise-by-cruise basis, depth-weighted concentrations were calculated for both the surface-to-20-metre stratum and the entire water column. No significant (P is greater than or equal to 0.05) differences between the surface and the whole water column were found during isothermal conditions. However, during stratified conditions in late summer, significantly lower surface values were found for arsenic, chromium and iron.

062837
NIAGARA RIVER TOXICS COMM * **The Niagara River Toxics Projects, status report** * 21p * NY State Dep Environ Conserv * 1983-02.

In February 1981, a joint Canada/United States team of scientists and engineers began a comprehensive investigation of toxic chemicals in the Niagara River. Though there have been investigations and reports on water quality in the river, leading to heightened public concern for improving health and environmental safeguards, no investigation until now has attempted a thorough and integrated study of the river. This joint investigation will make recommendations as to what should be done to reduce or remove the contamination and to monitor the effectiveness of clean-up programs. This Status Report describes the investigation by the joint Canada/United States team. It describes where the project stands as the investigators wrap up two years of information-gathering and begin nine months of examining the data and drawing up recommendations to be made to their respective governments. The status report is presented in two sections. Section One is a description of the toxic contamination concerns in the river, the objectives of the study, the projects undertaken by the investigators and the likely form of the final report, due in December 1983. Section Two is a summary and status, as of February 1983, of the 39 individual subprojects which make up the whole investigation.

063506
NICHOLAICHUK W, GROVER R * **Loss of fall-applied 2,4-D in spring runoff from a small agricultural watershed** * J Environ Qual * 12(3) 412-414 * 1983-07.

The loss of 2,4-D(2,4-dichlorophenoxyacetic acid) applied in fall to wheat (Triticum aestivum L.) stubble on fields of Wood Mountain loam soil in semiarid southwestern Saskatchewan was measured in surface runoff from snow. The range of runoff volumes over the 6-y period was representative of runoff observed over a 30-y period at the same location. The loss of 2,4-D was greater from the treated stubble compared with fallow,

which served as the control. The average loss from the control of 1.3 g/ha gives an indication of background limits that can be expected if 2,4-D is applied a year earlier. The 2,4-D loss in snowmelt runoff is similar to losses in rainfall runoff from a severe storm soon after application. The 6-y average loss was 4.1% of the amount applied (0.42 kg/ha). Correlation analysis showed the amount of loss to be a function of runoff. The average flow-weighted mean concentration of 31 micro g/L was well below the USEPA maximum permissible level of 100 micro g/L, and slightly above the U.S. National Academy of Sciences and National Academy of Engineering objective of 20 micro g/L for drinking-water standards.

062487
NICHOLLS KH, BEAVER JL, EASTABROOK RH * **Lakewide odours in Ontario and New Hampshire caused by Chrysochromulina breviturrita Nich. (Prymnesiophyceae)** * Hydrobiologia * 96(1) 91-95 * 1982-10-01.

At densities of 500-9000 cells/ml, the planktonic algae Chrysochromulina breviturrita Nich. produced obnoxious lake-wide odours in five lakes between 1978 and 1980. In one case, CuSO4 was used to kill the organism and control the odour, but in the other four lakes, the species persisted for 4-6 weeks before populations declined and odours disappeared. This is the first recorded instance of odour production by any member of the Prymnesiophyceae.

063685
NICHOLLS KH, BEAVER JL, ESTABROOK RH * **Lakewide odours in Ontario and New Hampshire caused by Chrysochromulina breviturrita Nich. (Prymnesiophyceae)** * APIOS Rep No 001/81 * 10p * Ont Minist Environ * 1981.

At densities of 500-9000 cells/ml, the planktonic alga Chrysochromulina breviturrita Nich. produced obnoxious lake-wide "rotten cabbage" or "garbage dump" odours in four lakes in Ontario and one lake in New Hampshire. In one case, CuSO4 was used to kill the organism and control the odour, but in the other four lakes, the species persisted for 4-6 weeks before populations declined and odours disappeared. This is the first recorded instance of odour production by any member of the Prymnesiophyceae. Lakewater based cultures of C. breviturrita were not toxic to mice when given as drinking water or as intraperitoneal injections. However, owing to the taxonomic affinity of C. breviturrita to Prymnesium parvum Carter, which produces a potent ichthyotoxin, and to the ability of C. breviturrita to develop large populations in the wild, additional bioassays with fish and tadpoles are necessary. The known distribution of C. breviturrita includes more than 40 lakes, 80% of which have pH and alkalinity less than 6.9 and 10 mg CaCO3 per L, respectively.

066848
NONPOINT SOURCE CONTROL TASK FORCE, WATER QUALITY BOARD, INTERNATIONAL JOINT COMMISSION * **Nonpoint source pollution abatement in the Great Lakes Basin, an overview of post-PLUARG developments** * 129p * Int Jt Comm, Great Lakes Reg Off, 100 Ouellette Ave, Windsor, Ont N9A 6T3 * 1983-08.

This report reviews the present state of programs and means of controlling nonpoint sources of pollutants in the Great Lakes Basin within the United States and Canada, and focuses on the changes that have taken place since completion of the Pollution from Land Use Activities Reference Group (PLUARG) report in 1978. Post-PLUARG developments discussed in detail include nonpoint source control programs, agricultural practices and urban practices in both Canada and the United States, and scientific and technical issues such as priority management areas, transport and transformations of point and nonpoint source phosphorus, phosphorus bioavailability, pesticides, wind erosion, and evaluation of program effectiveness, which were identified by PLUARG and which require further investigation. Response to PLUARG's recommendations is also included. The Task Force concluded that cost-effective management practices and implementation programs are generally available and have been demonstrated in the Great Lakes Basin but that there is a continued need for the development of a comprehensive management strategy to control pollution from land runoffs in the Basin. Eleven recommendations for further action are also presented.

065794
NOVAK Z, WHITEHEAD BA * **Urban stormwater quality, Devon pilot catchment, City of Stratford** , IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * v2 979-999 * Can Soc Civ Eng * (1983).

Data on precipitation, stormwater runoff and runoff quality were collected for a wide range of hydrologic events from a typical urban catchment - Devon, in the City of Stratford. The data were analysed to define precipitation, runoff and pollutant inter-relationships in order to characterize the typical runoff pollutant loadings on an event and seasonal basis. The event pollutant loading increases with increasing runoff volume while the average event concentration decreases with increasing runoff volume. Smaller runoff events however, occur more frequently and as a result, contribute the major portion of the total seasonal pollutant loadings. Higher pollutant concentrations were found at the early stages of the runoff event. Relatively small water quality ponds can

effectively reduce seasonal pollutant loadings to a receiving stream by natural settling. These ponds can capture small runoff events plus the first portions of larger runoff events.

062379
NRIAGU JO, WONG HKT, COKER RD * **Deposition and chemistry of pollutant metals in lakes around the smelters at Sudbury, Ontario** * Environ Sci Technol * 16(9) 551-560 * 1982.

Analyses of the suspended particulates in lakes within a 30-km radius of the smelting complex at Sudbury show average Ni, Cu, Zn, and Pb concentrations of 1500, 420 540, and 360 micro g per g, respectively. Organic matter constitutes 35-60% of the suspended material in the lakes but plays a minor role in the transport of metals to the sediments. The rates of metal accumulation in the sediments have been estimated typically to be 100-600, 50-300, 16-60, and 5-30 mg per sq m per year for Ni, Cu, Zn, and Pb, respectively. The enrichment factors for metals in surficial sediments typically are 12-115 for Ni, 10-77 for Cu, 2-10 for Pb, and 2-8 for Zn. These enrichment factors and deposition rates for Ni and Cu are among the highest recorded anywhere in the world. Some of the lakes with pH values of 4.5 or less show no enrichment or accumulation of pollutant metals in their surface sediments, indicating that pollutant metals previously stored in the sediments have since been leached away. This documentation that the contaminated sediments can release substantial quantities of toxic metals to the overlying water must have interesting ramifications with regard to the limnological impacts of acid rains.

064898
NRIAGU JO, WONG HKT, SNODGRASS WJ * **Historical records of metal pollution in sediments of Toronto and Hamilton harbours** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

062382
OLIVER BG, BOTHEN KD * **Extraction and clean-up procedures for measuring chlorobenzenes in sediments and fish by capillary gas chromatography** * Int J Environ Anal Chem * v12 * 13 ref, 2 fig, 3 tab * 1982.

A soxhlet extraction technique for recovering chlorobenzenes from sediments and fish is described. The exact is concentrated by evaportation, cleaned up with florisil (sediments) or a combination of alumina, silica gel, florisil and acidified gel (fish) before quantitation by capillary gas chromatography with an electron capture detector. Recoveries for all chlorobenzenes are greater than 80%. Detection limits of the technique are approximately 0.05 ng/g (ppb) for penta- and hexachlorobenzene, approximately 0.2 ppb for the tetrachlorobenzenes, approximately 0.4 ppb for the trichlorobenzenes, approximately 5 ppb for the dichlorobenzenes, and approximately 1500 ppb for monochlorobenzene.

062702
OLRIK K, CHRISTENSEN JH * **Toxic algae: an environmental and health problem in coastal areas and lakes** * Can Transl Fish Aquat Sci 4947 * 10p * Dep Fish Oceans, Quebec Reg, Quebec, Que * 1983.

Mass occurrences of harmful plankton algae, lack of oxygen and fish deaths occurred in Denmark in 1975-76 and 1981 when extreme meteorological conditions coincided with extreme environmental developments in coastal waters. This article discusses the occurrence of the toxic algae, contingency plans to deal with the occurrence, and possible control measures to be taken.

061976
ONT MINIST ENVIRON, NORTHEAST REG, NORTH BAY DIST, MUNIC PRIV ABATEMENT * **Community pollution survey, Trout Lake, City of North Bay, 1981** * 15p * Ont Minist Environ, Toronto, Ont * 1981.

This report presents the results of a summer 1981 survey of private sewage disposal systems along the shore of Trout Lake, east of the City of North Bay, Ontario, which also serves as the municipal water supply for the City. The survey was done in three phases: Phase I irvolved Anita Avenue with 67 permanent homes and 11 recreational cottages inspected; Phase II combined Silver Lady Lane, Wild Cherry Lane, and part of Peninsula Road, with 51 permanent homes and 14 recreational cottages inspected; and Phase III included Reynold's Road and West Peninsula Road, with 29 permanent homes and 19 recreational cottages inspected. The classification of the sewage disposal system of each inspected property into one of six classes from direct polluter to satisfactory, is described. Survey techniques included visit and visual inspection of each property, interview with occupant, and water sampling for bacteria tests at selected locations. The survey revealed that most dwellings had satisfactory sewage disposal systems.

062836
ONT MINIST ENVIRON, TECH SUPPORT SECT, SOUTHEAST REG. * **Cottagers' self help program, enrichment status of lakes in the southeastern region of Ontario, 1983** * 138p * Ont Minist Environ, Tech Support Sect, SE Region Kingston, Ont * 1984.

During 1971 the Ministry of the Environment (MOE) initiated a Self Help Program to enlist the assistance of cottagers in monitoring lake water quality conditions. The program in Southeastern Ontario has expanded to include

114 volunteers gathering data for 94 lakes during 1983. Of these, 52 lakes have now been sampled for six or more years. This trend-through-time data are making an extremely valuable contribution towards the understanding of natural seasonal and yearly fluctuations in lake water quality conditions. This in turn will assist with the detection of any trends in water quality resulting from man's activities. This report has been and is published on an annual basis and presents the data for the lakes sampled in Southeastern Ontario during each specific year. The data are discussed in terms of within season and between year variabilities in algal productivity as reflected by chlorophyll concentrations. This system of expanding data is allowing the opportunity for a more thorough understanding of the water quality conditions of our lakes and the factors which influence these conditions.

063631
ONUSKA FI, MUDROCH A, TERRY KA * **Identification and determination of trace organic substances in sediment cores from the western basin of Lake Ontario** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

065406
OSBORNE LL, DAVIES RW, VENTULLO RM, LADD TI, COSTERTON JW * **The effects of chlorinated municipal sewage and temperature on the abundance of bacteria in the Sheep River, Alberta** * Can J Microbiol * 29(2) 261-270 * 1983-02.

The intersite and temporal differences in the abundance of sessile and planktonic bacteria subjected to a chlorinated municipal sewage discharge and a thermal discharge were investigated in the Sheep River, Alberta, from January through December 1978. Significantly higher densities of both sessile and planktonic cells generally occurred within the chlorinated effluent plume. Higher numbers of sessile bacteria were also found below the thermal discharge, with maximum densities occurring in the the late winter - early spring and minimum densities following mountain runoff. The higher numbers of sessile bacteria in the chlorinated plume was attributed to nutrient enrichment. These results indicate that chlorinated sewage effluent has no adverse effects on the abundance of sessile bacteria.

064410
OSCARSON DW, LIAW WK, HUANG PM * **The kinetics and components involved in the oxidation of arsenite by freshwater lake sediments** . IN: International Association of Theoretical and Applied Limnology, Proceedings, JP, 1980 * SLADECEK V * 21(1) 181-186 * E Schweiz Verlagsbuchhandlung, D-7000 Stuttgart 1, DE * 1981.

The kinetics and energies involved in the depletion (oxidation plus sorption) As(III)(arsenite) by freshwater lake sediments from Buffalo Pound, Pasqua and Katepwa lakes in southern Saskatchewan, are reported. The rate constant, K, ranges from 4.1 x 0.01 to 6.9 x 0.01 per hr at 5C and from 10.3 x 0.01 to 13.5 x 0.01 per hr at 25C. The sediments oxidize As(III)(arsenite) to As(V)(arsenate) and the depletion is shown to be predominantly a diffusion-controlled process. Selectively removing Mn from the sediments with NH2OH - HCl greatly decreases the oxidation of As(III). Also, a synthetic MnO2 compound is effective in oxidizing As(III). Results indicate that Mn(IV) oxidizes existing as discrete particles and/or coatings on other sediment components are the primary electron acceptors in the oxidation of As(III). The conversion of As(III) to As(V) is deemed to be important in maintaining the ecological balance in aquatic environments and in reducing the contamination of the food chain.

061977
OSTRY RC, TSENG T * **A preliminary method for evaluation of non-point sources** * 13p * Ont Minist Environ, Water Resour Branch * 1981-07.

This paper compiles available information on the characteristics of non-point pollution sources, and representative unit-area loads for major land uses, and presents an approach that could be used to estimate the relative magnitude of point and non-point sources inputs to receiving water bodies in Ontario. Dominant land use categories discussed are urban general, rural general, and wooded/idle. Comparisons and ranges of unit area loads (kg/ha/yr) for the major land uses are given for total phosphorus, filtered reactive phosphorus, total nitrogen, suspended sediment, chloride, lead, zinc, and copper. The general workability of the proposed approach is detailed for six river basins (Little Pic River, Magpie River, Duffins Creek, Bonnechere River, Grand River, and Saugeen River) of varying size across Ontario. Results suggest that the approach can be used to provide a reasonable first approximation of the non-point source contamination for any watershed. It is concluded that accuracy can be significantly improved if local knowledge and understanding of the study area is used in selecting more representative values from the ranges provided for the major land uses in each watershed.

058241
PACKMAN GA (COMPILER) * **Atlantic region laboratory quality control workshop, March 5-6, 1980, Proceedings** * Surveillance Rep Environ Prot Serv-5-AR-81-5 Atl Reg * Environ Prot Serv, Environ Can, Dartmouth, NS B2Y 2N6 * 142p * 1981-11.

The Regional Ocean Dumping Advisory

Committee has established a Laboratory Evaluation Committee to develop a mechanism for close liaison and frequent exchange of scientific information between government, consultant, university and other laboratories in the region. After developing the mechanism, this committee conducted a quality control round robin covering trace metals in sediments with specific emphasis on cadmium. As a follow up, this workshop discusses the findings of the round robin in detail and recommends a future course of action. The papers presented include the following topics: the Safe Drinking Water Act; the Ocean Dumping Control Act; marine quality control programs; the marine analytical chemistry standards program, National Research Council Reference materials program; the role of the Environmental emergencies Division; determination of cadmium in silicate; analysis of marine sediments; and an approach in trace analysis of heavy metals in aqueous samples.

063622
PALMER MD * **Fecal coliform loadings from birds on bridges** * Can J Civ Eng * 10(2) 241-247 * 1983-06.

The fecal coliform loadings to the Rideau River from bird populations resident on bridges were measured for dry weather, summer, low river flows (8.5 - 17 cu m per s). The Rideau River has typical velocities to 0.216 km per h. The loadings were estimated by an intensive river sampling program over 4 weeks at river cross sections upstream and downstream of a bridge with birds on the bridge and without birds on the bridge. The birds were temporarily displaced from the bridge with bird nets. Statistical testing of the river cross section geometric means showed the birds do have a significant effect on river fecal coliform levels. From bird census, river water sampling data, and river flow data, a pigeon was estimated to generate on the average a daily loading of between 0.88 and 1.3 x 10 sup 10 fecal coliform organisms with a standard deviation of approximately 0.39 x 10 sup 10. An independent check on the validity of the estimated loadings from resident bird populations at another bridge produced results within 40% of the measured values.

062341
PARKER JI, STANLAW KA, MARSHALL JS, KENNEDY CW * **Sorption and sedimentation of Zn and Cd by seston in southern Lake Michigan** * J Great Lakes Res * 8(3) 520-531 * 1982.

Recent estimates suggest that inputs of Zn and Cd to southern Lake Michigan exceed losses. We investigated the sorption and sedimentation of Zn and Cd by southern Lake Michigan seston particles using 65Zn and 109Cd in 21 radiotracer experiments. The time-series sorption by total seston greater than 0.45 micro m was asymptotic with apparent equilibria of approximately 100-200 ng ZN/L and approximately 1.0-2.0 ng Cd/L, occurring in approximately 24-30h during the summer phytoplankton bloom. Studies of the sorption by different particle size fractions showed that the abundance of phytoplankton and detritus control the concentrations of particle-bound Zn and Cd. The seasonal maximum concentrations of particle-bound Zn and Cd correlated well with the development of both the summer and fall phytoplankton blooms. Serial additions of Zn and Cd in combination with the radiotracers showed that these additions inhibit the sorption of both metals as their toxic effects are expressed. Coupling of the particle-bound Zn and Cd estimates for the period May to December with data on the seasonal variations in the net settling velocity in southern Lake Michigan provided annual sedimentation rates of approximately 9 micro g Zn/sq cm yr and approximately 0.1 micro g Cd/sq cm yr that are in excellent agreement with similar estimates by other investigators. Likewise, dividing our particle-bound estimates by the dry weight of total seston in the samples provided sediment concentration estimates of approximately 38-185 ng Zn/mg dry weight (ppm) and 0.5-2.3 ng Cd/mg dry weight that agree with measured levels from the surficial Lake Michigan sediment. The results of these experiments suggest that, if the dissolved concentrations of Zn and Cd do increase to toxic levels, the impacts on phytoplankton may potentiate further increases in the dissolved levels by reducing plankton sorption and removal by sedimentation.

063274
PATRY GG * **A linear programming model for the control of combined sewer systems with off-line storage facilities** * Can Water Resour J * 8(1) 83-105 * 1983.

Because of the increasing relative importance of nonpoint sources of pollution generated by overflows from combined sewer systems, real-time control of these sewer networks is of increasing interest in the overall pollution control management program. After reviewing the various levels of control applicable to combined sewer systems, the paper describes a linear programming model designed to minimize the impacts on the receiving waters. The model handles time and spatial sensitivity of the receiving waters as well as off-line storage facilities. An example illustrates the sensitivity of the model to various input parameter variations.

F10810
PECHES OCEANS * **Cheminement des toxiques dans l'environnement** , IN: Compte rendu des commun du sentieme atelier annuel sur la toxicite aquatique: du 5 au 7 nov 1980, Montreal, Que * BERMINGHAM N, BLAISE C, COUTURE P, HUMMEL B, JOUBERT G, SPEYER M * Rapp tech can sci

halieut aquat no 990 * 413-414 * Peches Oceans, 240 Sparks, Ottawa, Ont * 1981-03.

L'O.C.D.E. se propose d'etablir une serie de tests qui pourraient etre utilises dans le but d'evaluer les effets toxiques potentiels de produits chimiques dans l'environnement; celle-ci proposerait une methodologie qui correspondrait a un systeme d'etude "par etape" ou des points de decision, permettant de passer d'une etape a l'autre, seraient definis.

063535
PEDERSEN TF * **Dissolved heavy metals in a lacustrine mine tailings deposit - Buttle Lake, British Columbia** * Mar Pollut Bull * 14(7) 249-254 * ISSN 0025-326X * 1983-07.

Dissolved Zn, Cu and Cd concentrations in interstitial waters collected from a lacustrine mine tailings deposit indicate that the tailings are not releasing heavy metals to the overlying lake water at present, and there is no evidence to suggest that significant oxidation is occurring in the deposit. The lake waters are enriched in metals from surface drainage, however, while pore waters in natural sediments are heavy-metal-depleted. Diffusion into the natural sediments therefore tends to buffer the lacustrine metal load, but only to a very limited extent.

062424
PETT RJ, ROFF JC * **Some observations and deductions concerning the deep waters of Hudson Bay** (see chapter 4.6 for complete reference - voir chapitre 4.6 pour la reference complete)

066162
PIERSON DC, TAYLOR CH * **The influence of snow on the input and movement of cations within a small watershed: methods and preliminary results** . IN: Proc Thirty-seventh Annual Eastern Snow Conf, June 5-6, 1980, Peterborough, Ont * GOODISON BE * 182-184 * (1980).

As part of a detailed investigation of the flux of major cations within a small watershed near Peterborough, Ontario, the snowpack was examined in an attempt to quantify its importance as a source of nutrients. A peak snow survey in which samples were collected from open fields and wooded areas, and a t-test have shown that the vegetation overlying the snowpack can cause significant variations in its Ca^{++}, Mg^{++} and Na^{+} concentrations. The snowpack had a total cation concentration of 1.85 kg/ha which accounted for 82% of the cation input to the watershed during the 1980 spring snowmelt period and also accounted for 46% of the water input to the watershed over the same period. There was a net cation export of 4.09 kg/ha from the watershed from March 20 to March 22, 1980. The snowpack could have accounted for a maximum of 45% of this. Data have shown that nutrient export is related to stream discharge.

062307
PLAA GL * **Present status: toxic substances in the environment** . IN: Toxic substances in the environment, Proc Symp held at Kingston, Ont, 12-13 Dec 1981 * NAKATSU K, BRIEN JF * v60 1010-1016 * 1982.

"Environmental toxicology" and "ecotoxicology" are defined and the characteristic components of each discussed. The sources of chemical pollution (production and use of energy sources and industrial chemicals; increased agricultural practices) and their dispersion in the environment are put into perspective. Characteristics of some chemical pollutants are summarized. The problems facing these branches of toxicology as predictive disciplines are briefly presented.

062391
PLATFORD RF, CAREY JH, HALE EJ * **The environmental significance of surface films: Part I-Octanolo-water partition coefficients for DDT and hexachlorobenzene** * Environ Pollut Ser B * v3 125-128 * Ripple Road, Barking, Essex, GB * 1982.

The partition coefficients for DDT and hexachlorobenzene (HCB) between two solvents and water are reported. The molar partition coefficient between either octanol or nine weight percent cetanol in octanol and water is 10 to the power of 5.1 plus or minus 0.2 for DDT and 10 to the power of 5.2 plus or minus 0.2 for HCB, all at room temperature. If the alcohols are in the form of a surface layer, the partition coefficient may be as high as 1,000,000 for the DDT and 10,000,000 for the HCB which suggests that the surface layer is a more important concentrator of organic solutes than is inferred from bulk partitioning values.

063883
POMEROY WM * **Receiving environment conditions in the vicinity of French Creek sewage outfall, Vancouver Island, B.C., (1977-1980)** * Reg Program Rep 82-12 * 58p * Environ Prot Serv, Pac Reg, Dep Environ * 1982-10.

The impact of the French Creek sewage discharge on the receiving environment was monitored by the Environmental Protection Service from 1977 to 1980. Water quality characteristics of salinity, temperature, dissolved oxygen and nutrients, and benthic characteristics of sediment particle size, organic content, heavy metal concentration and benthic fauna were investigated. The Pisces IV submersible was used to examine physical features of the diffuser, immediate effects on the substrate and obvious responses of the organisms to the presence of the discharge. Results to 1980 suggested some minor effects

which could be attributed to the discharge of effluent from a biological secondary treatment plant. Water quality characteristics were typical of the Strait of Georgia showing normal seasonal variations. Distribution patterns of sediment particle size reflected a natural rather than an outfall induced situation. Sediment organic content measured in 1980 showed a significant increase over the 1977 pre-discharge levels, an obvious effluent effect. An overall increase in copper, manganese, iron and nickel in sediments at most stations was also suggestive of a discharge effect. Polychaete worms were the most common form of infauna, being recorded in great abundunce over the entire study area in 1977. Species density was greatest east of the outfall. Evenness or the distribution of individuals amongst species was high (0.679 to 0.850) along with species diversity index. Pre-operational levels (1977) of heavy metals in the tissue of english sole varied from station to station with lead and cadmium below detection. A further sampling in 1980 indicated elevated levels of iron and zinc suggesting a possible discharge effect. Further sampling of more resident species is required to confirm this effect. Observations from Pisces IV submersible dives indicate no major adverse physical effect on the substrate in the vicinity of the diffuser Invertebrate colonization of the pipe and the presence of large numbers of rockfish were noted in a dive about 1 1/2 years after outfall installation. Little non-biodegradable debris was present. One point to note was the undercutting occurring at some points along the outfall and diffuser pipe. Future examinations should be made to note any weakening.

064315
PREPAS EE * **Orthophosphate turnover time in shallow productive lakes** * Can J Fish Aquat Sci * 40(9) 1412-1418 * 1983-09.

Orthophosphate turnover times were measured in 18 small and medium-sized lakes in western Canada. Turnover times in eight thermally stratified lakes were similar to those of other Canadain lakes: moderately rapid (up to 42 min) in the spring, increasing to very rapid (3-16 min) during July and August. Turnover times in the shallow (i.e. those which mixed intermittently during summer) productive lakes were far more vaiable, ranging from 17 min to 17 h in spring and 2 min to 36 h during July and August. For individual shallow lakes turnover times remained constant for particular summers. One shallow lake was studied over 2 summers. In the first summer, turnover times were extremely slow (7-36h) and in the second summer they were extremely rapid (2-11 min). Therefore I suggest that the mechanisms controlling nutrient limitation in shallow productive lakes are not constant, and can vary dramatically from year to year.

066622
PREPAS EE * **The influence of phosphorus and zooplankton on chlorophyll levels in Alberta lakes** * RMD Rep 83/23 * 111p * Alberta Environ, Res Manage Div * 1983-08.

Data were collected on 20 lakes in central Alberta to determine if: (1) local lakes are phosphorus-limited; (2) predictable patterns exist in the return of phosphorus from the sediments; and (3) including an estimate of zooplankton biomass would improve the phosphorus-chlorophyll models for local lakes. It was found that both the total phosphorus (TP)-chlorophyll a (Chl a) relationship and the total nitrogen (TN) to TP ratios were similar to those reported for otner northern temperate lakes which are considered phosphorus limited. However, more variability in the spring TP-summer Chl relationship was found than reported elsewhere. This variation was caused by unexpectedly large seasonal fluctuations in TP levels in the surface waters. Temporal variations (May to Sept.) in TP were dependent on the amount of phosphorus released from the sediments and on mixing depth. The shallow lakes stratified intermittently and during these periods, the (TP) in the water above the sediments increased as dissolved oxygen levels approached zero. Later, when the lake mixed, this phosphorus was incorporated into the surface waters. The deep lakes were all partially meromictic, and (TP) increased in the hypolimnion during summer. The rate of phosphorus release from the sediments of deep lakes was correlated with mean summer (chl a). During the summer, the (TP) in the surface waters of the deep lakes stayed constant or declined, except in late summer when the thermocline was depressed and dissolved phosphorus had accumulated at the top of the hypolimnion. An estimate of the large zooplankton biomass improved the spring TP-summer Chl a relationship for local lakes. However, this term did not improve the summer TP-summer Chl a relationship in the same lakes.

062430
PRINSENBERG SJ * **Present and future circulation and salinity in James Bay** (see chapter 4.6 for complete reference - voir chapitre 4.6 pour la reference complete)

064132
RAMAMOORTHY S, MOORE JW * **Chemical agents of environmental concern in Alberta waters: a bibliography, Part II: mercury and cadmium** * AECV83-B1 * 81p * Alta Environ Cent, Vegreville, Alta T0B 4L0 * 1983-05.

This is a bibliographic report on mercury and cadmium found in surface waters. Some 1100 references, dealing with the toxicity, discharges, behaviour, residue dynamics, genetic toxicology, impact on natural populations and management/monitoring

strategies for mercury and cadmium, are cited.

064124
RAMAMOORTHY S, MOORE JW * **Chemical agents of environmental concern in Alberta waters: a bibliography, Part 1: Organic compounds** * 85p * Alta Environ Cent, Vegreville, Alta T0B 4L0 * 1982-12.

This is a bibliographic report on organic compounds commmonly found in surface waters. Some 1300 references, dealing with the chemistry, production, uses, behaviour, residue dynamics, toxicity, impact on natural populations, methods of analysis, and management/monitoring strategies of organics, are cited.

067179
RAY S, MACKNIGHT SD * **Trace metal association with suspended particulate matter due to dredging of Miramichi estuary, N.B., Canada** . IN: Int Conf Heavy Metals in the Environment, Heidelberg, September 1983 * Mueller G (chairman) * 976-979 * CEP Consult Ltd, 26 Albany St, Edinburgh EH1 3QH GB * 1983.

Cu, Zn, Cd, Pb, Fe and Mn concentrations in sediment and suspended particulate matter (SPM) of the Miramichi estuary were monitored prior to and during dredging. The observed variation in metal concentrations of sediment and SPM prior to dredging could be attributed to the physicochemical environment of the estuary. Wide variation in natural levels of the metals effectively masked any subsequent change due to dredging.

F12175
REEDER SW * **Lignes directrices concernant la qualite des eaux de surface, Vol. 1 Les substances chimiques inorganiques, expose preliminaire** * 19p * Environ Can, Dir gen eaux inter, Dir qual eaux, Ottawa, Ont * 1983.

Le present rapport sert d'introduction a une serie de directives sur la qualite des eaux, lesquelles vont etre publiees en trois volumes au fur et a mesure qu'elles seront etablies. Le volume 1 va traiter des composes inorganiques, le volume 2, des composes organiques et le volume 3, des caracteristiques physiques, microbiologiques et radiologiques. Les directives fournissent des renseignements sur les sources, les cas de presence et les formes des principaux constituants et polluants des eaux. La concentration maximale du constituant est precisee pour chaque utilisation des eaux-reserves d'eau publiques et agricoles, exigences des organismes aquatiques, de la faune, de l'esthetique et des loisirs, ainsi que besoins de l'industrie alimentaire. Ces limites sont fondees sur des donnees scientifiques recentes et chacune est determinee en fonction de l'optimalisation de l'utilisation. Chaque volume renferme un rapport preliminaire semblable au present rapport. Un tableau general definit les objectifs de chaque utilisation particuliere des eaux pour chacun des constituants presentes dans le volume. Ce tableau general va etre modifie a mesure que des donnees supplementaires sont obtenues et publiees. Le rapport preliminaire traite en outre des limitations des objectifs fixes pour les differentes utilisations des eaux et de leur mise en application dans les programmes de controle de la pollution des eaux. Les tableaux de chaque utilisation des eaux comparent les donnees sur les limites de la qualite des eaux de surface publiees par d'autres organismes.

F12184
REEDER SW, DEMAYO A, TAYLOR MC * **Lignes directrices concernant la qualite des eaux de surface, Vol. 1 Les substances chimiques inorganiques, le mercure** * 16p * Environ Can, Dir gen eaux inter, Dir qual eaux, Ottawa, Ont * 1983.

On a effectue une etude de la documentation portant sur les effets toxiques du mercure et de composes du mercure sur les humains, les organismes aquatiques, les plantes et le betail. Ces donnees sont resumees dans cette publication. En se basant sur ces donnees, on propose des valeurs des concentrations maximales de mercure dans l'eau auxquelles on n'observe pas d'effets toxiques.

F12182
REEDER SW, DEMAYO A, TAYLOR MC * **Lignes directrices concernant la qualite des eaux de surface, Vol. 1 Les substances chimiques inorganiques, le cadmium** * 20p * Environ Can, Dir gen eaux inter, Dir qual eaux, Ottawa, Ont * 1983.

On a effectue une etude de la documentation portant sur les effets toxiques du cadmium et de composes du cadmium sur les humains, les organismes aquatiques, les plantes et le betail. Ces donnees sont resumees dans cette publication. En se basant sur ces donnees, on propose des valeurs des teneurs maximales en cadmium dans l'eau auxquelles on n'observe pas d'effets toxiques.

066137
REYNOLDSON TB, HAMILTON HR * **Spatial heterogeneity in whole lake sediments - towards a loading estimate** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

063943
REYNOLDSON TB, LIVINGSTONE S * **Effects of spring runoff on the North Saskatchewan River in the City of Edmonton** * 26p * Alta Environ, Pollut Control Div, Water Qual Control Branch * 1982-02.

A study was undertaken to identify possible

causes of the taste and odor problems associated with spring runoff in Edmonton drinking water. Results showed a measureable change in water quality between the two water treatment plants. The North Saskatchewan River at the E.L. Smith water treatment plant upstream showed little change in measured parameters over the runoff period. At Rossdale, downstream of a number of major storm sewers, the river showed considerable change in water quality. These changes, in major ions, metals and organics, were coincident with occasions when runoff was discharging to the river via the storm sewers. The chemistry of, and flow from, the storm sewer discharge was extremely variable but predictable on a diurnal pattern. A preliminary mass balance suggests that the storm sewers are the major contributor to changes in water quality during spring runoff.

065695
RIBO JM * **Chlorinated aromatic compounds: MICROTOX test results and structure-toxicity relationships** * Natl Water Res Inst Unpublished Manuscr #84-03 * 39p * Environ Can, Natl Water Res Inst, Inland Waters Dir * (1984).

The toxic effects of chlorosubstituted benzenes, phenols, anilines, nitrobenzenes and pyridines to the luminescent bacteria Photobacterium phosphoreum have been determined using the Microtox test. Quantitative relationships between these toxicity values and certain compound specific structural parameters make it possible to develop a mathematical model for the prediction of their toxicities to aquatic biota. The dependance of the test results on variables such as temperature, pH, exposure time, age of the bacteria culture, etc., are discussed as well as the correlations of the Microtox values with the effects of these compounds on other organisms which are commonly used for aquatic toxicity studies.

066142
ROBBINS JA * **Stratigraphic and dynamic effects of sediment reworking by Great Lakes zoobenthos** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

F10753
ROBERTS JR, MITCHELL MF, BODDINGTON MJ, RIDGEWAY JM, MCGARRITY JT, MARSHALL WK * **Controle de la persistance relative de produits organiques lipophiles dans les ecosystemes aquatiques - analyse du role d'une simple simulation par ordinateur. I. Controle de la persistance par simple simulation par ordinateur. II. Introduction a l'analyse des differents processus et son utilisation dans le controle preliminaire de la persistance chimique** * CNRC no 18571 * 331p * Cons natl rech Can, Ottawa, Ont * 1982.

Il existe bien plus de 20,000 composes industriels que l'on doit examiner pour leurs effets nuisibles possibles sur l'environnement. On sait qu'avec les methodes traditionnelles il est quasiment impossible de les evaluer tous. Ce document traite d'un aspect du probleme, a savoir comment controler leur persistance dans des systemes aquatiques. Les auteurs etudient l'utilite d'une simple simulation par ordinateur pour prevoir le comportement et le sort ultime d'un polluant dans des ecosystemes aquatiques. La simulation est basee en grande partie sur les proprietes chimiques et physiques du polluant qui sont faciles a obtenir. La simulation vise non pas a traduire des situations reelles mais plutot a prevoir le sort du polluant dans un ecosysteme aquatique artificiel afin de faciliter l'identification des modeles de comportement. Ceux-ci, de concert avec des benchmarks ou programmes-repere, peuvent etre employes pour caracteriser la voie critique et la persistance relative du polluant. Les auteurs pretendent que l'on ne saurait effectuer des evaluations valables au moyen de telles simulations sans au prealable mettre au point une serie bien caracterisee de programmes-repere. Dans leur rapport, ils examinent en detail les proprietes qui servent a caracteriser les programmes-repere. Les auteurs trouvent que de telles simulations s'averent particulierement utiles pour juger si l'on peut formuler des evaluations valables du sort d'un polluant. La deuxieme partie du document examine de pres les divers processus qui determinent le sort ultime d'un polluant afin de preciser jusqu'a quel point la prevision de leurs vitesses est exacte.

065599
ROBINSON M, JAMES W * **Co-ordinated multiprocessing for real-time control of urban drainage** (see chapter 4.3 for complete reference - voir chapitre 4.3 pour la reference complete)

065588
ROBINSON MA, JAMES W * **Continuous SWMM modelling of summer stormwater runoff quality in Hamilton, preliminary output time series analysis** (see chapter 4.3 for complete reference - voir chapitre 4.3 pour la reference complete)

F10461
ROCHE ASSOC LIMITEE * **Complexe La Grande phase II, etude des milieux lacustres et lotiques de la region EM 1, rapport d'expedition** * Roche assoc limitee, Sainte-Foy, Que * 1980-08.

Le present rapport d'expedition s'inscrit dans le cadre de l'etude des milieux lacustres et lotiques de la region de EM-1. Il presente en detail les activites realisees sur le terrain ainsi que tous les resultats obtenus

au cours de la phase exploratoire. Le principal objectif de la campagne de terrain menee en juillet 1980, etait de recueillir les donnees et l'information permettant de decrire les peuplements piscicoles et l'habitat aquatique des divers plan d'eau du territoire EM-1. La campagne a egalement permis d'effectuer, dans la region a l'etude, une tournee d'echantillonnage des plans d'eau dans le but de realiser une etude detaillee de la qualite de l'eau du territoire. Les resultats sont fournis dans les huit annexes qui composent en majeure partie ce document.

065817
RODGERS PW, SWAIN WR * **Analysis of polychlorinated biphenyl (PCB) loading trends in Lake Michigan** * J Great Lakes Res * 9(4) 548-558 * 1983.

PCB concentrations in coregonid fishes (bloater chubs) collected from Lake Michigan between 1972 and 1980 are used to infer an historical loading trend for polychlorinated biphenyls (PCBs). A mass balance model was developed to describe the dynamics of PCBs by assuming that historical fish concentrations are proportional to concurrent water column concentrations of PCB. The validity of this assumption is strengthened, since the data represent a single species of fish (a pelagic feeder), a specific age class of that species, and a single laboratory performing the collections and analysis of the data. The results of model analysis indicate that PCB loading to Lake Michigan during the period of observation can be described by a linearly decreasing trend. The calibrated model also forecasts the response of selected fish species to various loading scenarios. Forecast results indicate that a continuously decreasing load will result in compliance with U.S. and Canadian guideline value for human consumption by 1987. However, should PCB loadings not continue to decrease, compliance with the proposed U.S and extant Canadian guideline of 2.0 mg/kg is doubtful. Forecast accuracy may be improved by the availability of precise measurements of water:fish distribution coefficients.

F11114
ROGEL JP * **Un paradis de la pollution** * 275p * Presses de l'Univ du Que, Sillery, Que * 1981.

Des villes recouvertes par des brouillards de pollution, des lacs envahis par des algues ou empoisonnes par les pluies acides, des terrains vagues jonches de detritus: a priori, le Quebec n'a rien a envier a ses voisins, et vit comme eux le cauchemar ecologique des societes industrielles modernes. La baisse du rendement moyen des peches sportives au cours des dix dernieres annees, de meme que le nombre croissant des "avis de faire bouillir l'eau potable" expedies aux municipalites et l'augmentation du nombre de cas de maladies respiratoires dans les quartiers industriels sont des indices qui ne trompent pas. Negligeables il y a 30 ou 40 ans, les couts sociaux et economiques de la lutte a la pollution deviennent aujourd'hui exorbitants. Que la prevention de la pollution a la source et le recyclage soient la meilleure facon d'eviter la pollution est une evidence qu'on a pas besoin de demontrer. Qu'ils permettent des economies et qu'ils soient "rentables" apparait de plus en plus clairement aussi.

065531
ROGERS IH, MAHOOD HW * **Environmental monitoring of the Fraser River at Prince George. Chemical analysis of fish, sediment, municipal sewage and bleached kraft wastewater samples** * Can Tech Rep Fish Aquat Sci 1135 * 19p * Dep Fish Oceans, West Vancouver Lab, West Vancouver, BC * 1982-12.

In October 1980 a field study was conducted at Prince George, B.C. by the Environmental Protection Service, Environment Canada. Six species of fish and sediment samples were taken from the Fraser River at four sites upstream of and just below two pulp mill discharges and the main municipal sewage outfall. Wastewater samples from these sources were also collected. All samples were analysed for chlorinated organic compounds. The results indicate the absence of detectable levels of chlorinated organic compounds or resin acids in fish that utilize the river in the area of the wastewater discharges. There appears to be some contamination of river sediments from unknown sources. The quantitation of chloroform levels in the Fraser River is a matter deserving more detailed study because of its carcinogenic properties and a lack of information regarding its persistence and longterm release from chlorolignin in a fast flowing river.

066396
ROGERS IH, MAHOOD HW * **Thompson River survey. Chemical analysis of water, tissue and sediment samples collected August 1981 to March 1982** * Can Tech Rep Fish Aquat Sci 1193 * 17p * Dep Fish Oceans, West Vancouver Lab, West Vancouver, BC V7V 1N6 * 1983-07.

The three major point-source wastewater discharges to the Thompson River are the Weyerhaeuser Canada Ltd. bleached kraft mill, the City of Kamloops municipal sewage treatment plant and the Gulf Oil refinery. Grab samples of the first two sources were collected for chemical analysis in September and November 1981 and in March 1982. A single sample of oil refinery effluent was collected in May 1982. Populations of rainbow trout - Salmo gairdneri and mountain whitefish - Prosopium williamsoni were sampled in the Thompson River below Kamloops Lake and upstream of McLure on the North Thompson River and near Chase on the South Thompson in August 1981. The fish were sampled a second time in

March 1982 during low water flow conditions.

064411
ROGERS JS, HUANG PM, LIAW WK * **Chemical dynamics of mercury sorption and desorption of freshwater sediments** . IN: International Association of Theoretical and Applied Limnology, Proceedings, JP, 1980 * SLADECEK V * 21(1) 174-180 * E Schweiz Verlagsbuchhandlung, D-7000 Stuttgart 1, DE * 1981.

This study reports the rates of sorption and desorption of mercury as influenced by temperature and the binding capacity for mercury of selected lake, river and creek sediments in the Canadian Prairies. Results indicate that the sorption and desorption of mercury by sediments obey multiple first order kinetics. The initial fast sorption process is exothermic. The rate constants of the slow sorption process exhibit little trend to temperature changes while the rate constants of the fast sorption range from 14 x 0.01 to 95 x 0.01 per hr and are 2-100 times higher than those of the slow sorption. The rate of the initial fast desorption process increases with increasing temperature, while the rate constants of the slow desorption decrease with increasing temperature. The capacity of the sediments to bind mercury varies from 17-24 mg mercury per g of sediment. The high sorption capacity of the sediments for mercury and the slow desorption process relative to the sorption process show that the bulk of mercury in aquatic environments is sorbed onto the sediments and may continue to be available from the sediments over some time.

F11790
ROUSSEAU R * **La methylation du mercure** * 201p * Dep genie civ, Ec Polytechnique, Univ Montreal * 1980-11.

Dans ce document, on tente de decrire l'etat actuel des connaissances sur le mercure, de degager les principaux facteurs impliques dans le cycle aquatique du mercure ainsi que l'impact de ce contaminant dans l'environnement. Les bacteries, les levures et les champignons sont les principaux microorganismes responsables de la synthese du methylmercure dans les ecosystemes aquatiques. A cause de l'utilisation intensive du mercure, de son rejet inconsidere dans l'environnement, de sa biotransformation en methylmercure par les microorganiques et de son accumulation dans la chaine alimentaire, on est maintenant aux prises avec un probleme dont la solution, dans l'immediat, semble plus que problematique. Il est donc imperieux d'intensifier les recherches dans ces domaines si le but vise est l'amelioration de la qualite de l'environnement. *

F10471
ROUY D, FAUBERT N * **Etudes limnobiotiques complementaires sur les rivieres Caniapiscau et Koksoak** (see chapter 2 for complete reference - voir chapitre 2 pour la reference complete)

065757
ROWNEY AC, CHEUNG PW, LOIJENS HS, PERKS AR * **Evaluation of fecal coliform bacteria sources in an urban stream** . IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * vi 221-240 * Can Soc Civ Eng * (1983).

An ongoing series of stormwater management studies have been made on the Rideau River at Ottawa to examine and identify control measures which could enhance or preserve water quality. This paper describes a part of that effort undertaken by the Rideau River Stormwater Management Study. Modelling and analytical techniques and extensive field measurements to evaluate dry and wet weather sources of fecal coliform bacteria are described in the context of this study. The calibration and use of STORM to simulate runoff of FC bacteria and the use of QUAL-II to simulate instream processes are described. Where they may be of general practical interest, conclusions of the study regarding sources and control of FC bacteria in an urban area are outlined.

F11644
ROY D * **Qualite de l'eau des rivieres Caniapiscau et Koksoak un an apres la coupure a Duplanter** * 8p * Groupe d'etude conjoint Caniapiscau-Koksoak, Soc energie de la Baie James, Montreal, Que * 1983-03.

Le Groupe d'etude conjoint Caniapiscau-Koksoak a recu le mandat de faire des etudes pour determiner les repercussions, s'il en est, causees par le detournement de la riviere Caniapiscau sur les poissons du reseau hydrographique des rivieres Caniapiscau et Koksoak. Une des causes de ces repercussions aurait pu etre une modification de la qualite de l'eau provoquee par la perte des eaux provenant du bassin superieur ou par l'erosion des berges exondees. Lors de l'elaboration de la grille d'impact, une premiere evaluation laissait entrevoir que les changements seraient mineurs. En 1981 cinq stations ont ete retenues pour un suivi eventuel du reseau de surveillance ecologique. Les resultats recueillis par l'equipe du reseau de surveillance de la Societe d'energie de la Baie James sont analyses. Dans un premier temps les valeurs des parametres observes apres la coupure sont comparees a celles obtenues avant octobre 1981, a la station la plus rapprochee du barrage. Par la suite cette comparaison est appliquee a l'ensemble de la riviere Caniapiscau.

065258
RUDD JWM, TURNER MA * **The English-Wabigoon River system: 2. Suppression of mercury and selenium bioaccumulation by suspended and bottom sediments** * Can J Fish Aquat Sci * 40(12) 2218-2227 * 1983-12.

Bioaccumulation of 203Hg and 75Se by several members of the food chain, including fish, was followed in large in situ enclosures in the presence and absence of organic-poor sediment. When the sediment was absent, 203Hg was bioaccumulated 8- to 16-fold faster than when it was either suspended in the water or present on the bottom of the enclosures. Mercury-contaminated and uncontaminated sediments were equally effective at reducing the rate of radiolabeled mercury bioaccumulation, apparently by binding the mercury to fine particulates making it less available for methylation and/or bioaccumulation. Based on these results, a mercury ameliorating procedure involving semicontinuous resuspension of organic-poor sediments with downstream deposition onto surface sediments is suggested. The presence of sediments, in the water or on the bottom of enclosures, also reduced radiolabeled selenium bioaccumulation.

065259
RUDD JWM, TURNER MA, FURUTANI A, SWICK AL, TOWNSEND BE * **The English-Wabigoon River system: 1. A synthesis of recent research with a view towards mercury amelioration** * Can J Fish Aquat Sci * 40(12) 2206-2217 * 1983-12.

Over a 3-yr period, teams from the federal Department of Fisheries and Oceans, the federal Department of the Environment, and the Ontario Ministry of the Environment researched the mercury pollution problem of the English-Wabigoon River system, northwestern Ontario, Canada. Mercury methylation and bioaccumulation were occurring mainly in the water column and surface layers of the sediments. Most mercury in the system was buried below the surficial sediments and probably does not contribute substantially to present mercury bioaccumulation. Movement of mercury between geochemical and biological compartments was rapid within the water column and surface sediments. Also, substantial amounts of inorganic and methyl mercury were transported down the river-lake system, having been released from stretches of river upstream of Clay Lake and deposited onto the surfaces of downstream lake sediments.

066130
RUST BR * **Sedimentation in fluvial and lacustrine environments** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

066502
SAMOILOFF MR, ARNOTT E, WEBSTER GRB, BELL J, BIRKHOLZ DA * **Evaluation of levels and kinds of toxic effects associated with chemical fractions of sediment from Tobin Lake, Saskatchewan** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

063634
SANDILANDS RG, MUDROCH A * **Nepheloid layer in Lake Ontario** * J Great Lakes Res * 9(2) 190-200 * 1983.

A study was designed to investigate the existence and extent of a nepheloid layer in Lake Ontario. A transmissometer profile of the entire water column was obtained monthly from 94 stations in Lake Ontario during the period of August to December, 1981. The profiles indicated that a turbid layer at the lake bottom existed over the entire lake at water depths greater than 60 meters. The thickness of the layer averaged 22 meters in August and September, but doubled to 45 meters in October. In addition, the average transmission was lowered from 60 percent in August and September to 45 percent in October. A significant increase in soluble reactive phosphorus (SRP) and reactive silica (RSiO2) in the nepheloid layer was observed. Quartz and calcite were the major mineral constituents of the suspended matter present in the layer. The particles in the nepheloid layer in the western basin of Lake Ontario consisted of many diatoms and some calcite particles and clay minerals. In the central and eastern basins the number of calcite particles significantly increased. Concentrations of Pb and Zn in the suspended matter sampled from the nepheloid layer at the Niagara River mouth were similar to those found in the 1-cm surface sediment at the same station (124 micro g per g Pb, 318 micro g per g Zn, and 139 micro g per g Pb and 356 micro g per g Zn, respectively).

F10973
SCHETAGNE R * **Influence des mises en eau du Complexe La Grande sur la teneur en mercure dans les poissons** (see chapter 4.13 for complete reference - voir chapitre 4.13 pour la reference complete)

F11050
SCHETAGNE S * **Prevision de la qualite de l'eau des reservoirs du Complexe Grande Baleine** * 30p * Soc energie de la Baie James, Montreal, Que * 1982-08.

Ce document a comme but principal la prevision de la qualite de l'eau des reservoirs et des biefs de detournement associes au Complexe Grande Baleine. La premiere section de ce document precise la qualite generale des eaux du Complexe Grande Baleine aux conditions naturelles. En second

lieu, il est question de la selection des parametres (au nombre de 21) devant faire l'objet de previsions. En troisieme lieu, la methodologie employee est decrite en detail et les resultats sont presentes sous forme de fiches. Les modifications qu'entrainerait un facteur d'utilisation de 76% sont ensuite traitees. Une breve conclusion sur la possibilite de developpement des organismes aquatiques selon les previsions de qualite de l'eau complete le document.

065507
SCHONEKESS PH * **Nose Creek water quality study** * 100p * Alberta Environ, Pollut Control Div * 1981-12.

The Nose Creek Water Quality Study was initiated by the Calgary Branch of the Water Quality Control Branch, Division of Pollution Control as part of a comprehensive Water Management Study for Nose Creek and West Nose Creek undertaken by Planning Division. The study was carried out from April to September of 1980. Seven creek locations were sampled on a weekly basis for various chemical and bacteriological parameters. During storm periods, storm sewer outfalls were sampled along with several key creek locations. In addition, dry-weather samples were collected from storm sewer outfalls for comparison purposes. The results of the study indicate that urbanization and associated storm sewer discharges have an appreciable effect on the water quality of Nose Creek and West Nose Creek. Concentrations of chemical parameters in the creeks within the urban area of Calgary can increase by as much as 49 times during storm events as compared to background values at the city boundary. In comparing the water quality of the creeks with published criteria on the suitability for various water uses, the water within the urban area is unacceptable for use as a public water supply. It is also unacceptable for direct contact recreations. However, secondary contact recreation would be suitable during certain periods (except during storm events). For livestock watering, the results indicate the water in Nose Creek and West Nose Creek would be unsuitable in the urban areas primarily due to pesticide concentrations. The water in the creeks in the rural areas is acceptable for irrigation unless it is used to irrigate vegetable crops or other crops consumed directly by man.

F10207
SCHREIER H, TAYLOR J * **Variations et mecanismes de distribution des fibres d'amiante dans les cours d'eau** * Etude no 118, Collect rapp tech * 18p * Environ Can, Dir gen eaux inter, Reg Pac et Yukon, Dir qual eaux, Vancouver, CB * 1981.

Peu de recherches ont ete orientees, sur la determination des causes des variations dans les fibres d'amiante ou sur les mecanismes de transport de ces fibres dans un cours d'eau. Vu l'inquietude persistante a propos des fibres d'amiante dans les approvisionnements en eau, il a semble opportun d'entreprendre une etude consacree a l'examen des variations spatiales et saisonnieres des concentrations de fibres d'amiante dans les cours d'eau et a l'identification des mecanismes de transport. Les resultats des recherches presentes dans ce rapport sont le fruit d'une annee d'etude dans le bassin de la riviere Sumas qui coule dans l'Etat de Washington et en Colombie-Britannique.

066694
SCHWEYEN T, LAST W * **Sedimentology and paleohydrology of Waldsea Lake, Saskatchewan** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

062234
SCOTT BF, NAGY E, HART J, AFGHAN BK * **New extraction/GC technique finds traces of water pollutants** * Ind Res Dev * 6p * 1982-04.

This article describes a new technique for extracting sample aids in preparation of specimens for analysis by gas chromatography. The technique is particulary applicable to determination of reactive chemical species in the environment. From time to time, small amounts of chemically and biologically active compounds, such as herbicides and insecticides, are released into the environment from research or manufacturing operations. At the National Water Research Institute, natural controlled systems have been constructed for exposing water, sediments, plants, and other aquatic life to known concentrations of certain reactive chemicals. At a Labcon in Rosemount, IL, September 1981, results of studies on the fate and impact of 2,4-D and 2,4-DCP were reported. The field study was conducted in 6 large ponds. An electron-capture (EC) detector was used, coupled to a gas-liquid chromatograph. Techniques for analyzing sediment, water samples, and particulate material were developed. A Perkin-Elmer 900-B gas chromatograph was used. Chemical manufacturers and plants using chemicals in treatment processes can unavoidably "leak" small quantities of reactive chemicals. The methods described in this article could be adapted by their quality control and analytical departments to detect reactive materials.

063527
SCOTT WS * **Factors influencing the behaviour of de-icing salts in an urban flood control reservoir** (see chapter 4.3 for complete reference - voir chapitre 4.3 pour la reference complete)

062330
SCRUDATO RJ, DELPRETE A * **Lake Ontario sediment - mirex relationships** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

F11709
SERODES JB, TALBOT L * **Projet de restauration du sud du lac Saint-Louis contamine par le mercure, deuxieme edition** * BEST-8 * 103p * Minist environ du Que, Bur des subst toxiques * 1980-08.

Cette etude constitue une synthese des connaissances actuelles sur la pollution mercurielle au sud du lac Saint-Louis. Les auteurs analysent en premier lieu la nature et l'importance des rejets provenant en presque totalite de l'usine de chlore et soude Standard Chemical Lted de Beauharnois. Le deuxieme chapitre decrit les caracteristiques physiques et chimiques des composantes atmospheriques et aquatiques du milieu recepteur. Le chapitre suivant fait etat des interventions sur le milieu; il passe en revue les actions entreprises au Japon et evalue diverses methodes de decontamination qui pourraient etre appliquees a la region du lac Saint-Louis. Enfin, certaines recommandations sont faites afin de restaurer cette partie du lac et de minimiser les risques que font encourir le mercure accumule dans les sediments.

064413
SHEAR H * **Contaminants programs in the North American Great Lakes Basin** . IN: International Association of Theoretical and Applied Limnology, Proceedings, JP, 1980 * SLADECEK V * 21(3) 1741-1748 * E Schweiz Verlagsbuchhandlung, D-7000 Stuttgart 1, DE * 1981.

Great Lakes surveillance and monitoring activities, toxicological research, chemical inventory and hazard assessment that deal with contaminants on an ecosystem basis, as set out in the 1978 Great Lakes Water Quality Agreement, are described. The chemical priority lists of Canada and the United States, which list those materials that should be monitored in the environment, are discussed. The fisheries component of the Great Lakes International Surveillance Plan, designed to give trend in time information on contaminants, both metals and organic compounds, in top predator fish (lake trout, rainbow trout, coho salmon) and a forage fish (rainbow smelt), is outlined. Contaminants being routinely analyzed for include mercury, copper, zinc, cadmium, nickel, lead, chromium, selenium, arsenic, PCB's, mirex, DDt and metabolites, dieldrin, chlordane and heptachlor epoxide. Other parts of the program discussed include monitoring of contaminants in phytoplankton, zooplankton and benthos, examining the effect on natural phytoplankton assemblages of heavy metals by size fractionation, and also examining the health of the fish community as a measure of ecosystem contamination. Control strategies, both Canadian and American, for the reduction or elimination of contaminants from discharges to the Great Lakes, is reviewed.

064545
SHEPHERD RB * **An evaluation of the Merritt sewage treatment plant, October 1980** * Reg Rep: 81-6 * 43p * Environ Prot Serv, Environ Prot Branch, Pac Reg, Environ Can * 1981-05.

The operation and performance of the Merritt Sewage Treatment Plant was evaluated over a 5-day period. Composite samples from three locations in the plant were analysed for numerous parameters including metals. Grab samples from several locations in the plant and the receiving waters were analysed for indicator bacteria, and a continuous 96-hour fish bioassay was run on the final effluent. The diurnal flow pattern and its effect on plant performance, as well as on the operation of individual components, are discussed and recommendations are made to improve treatment efficiency. Consequent improved effluent quality will reduce the impact on the fishery resources of the Coldwater and Nicola Rivers.

066616
SHERMAN K * **Water quality of Talbot Lake in relation to shoreline development, Laxton Township, Victoria County** * 22p * Ont Minist Environ * 1981.

A report is presented of a survey conducted on Talbot Lake in 1980 to outline the existing water quality status and to assess the effects of proposed additional development on the water quality status of the lake. The study area is described and the survey procedures are outlined. All results of physical and chemical samples taken are presented in an appendix. A discussion of the survey results presents pertinent data on physical characteristics of the lake, including information on its basic water chemistry, dissolved oxygen, nutrients, phytoplankton, benthic invertebrates and aquatic plants. A study of the supply of phosphorus to Talbot Lake from various sources showed that only 9% came from existing shoreline development. Concerns about the direct effect of cottage development on water quality of Talbot Lake are overshadowed by the indirect physical influence of associated recreational uses of the lake. The lake water quality is considered sensitive to mechanical disturbances of lake sediment through such uses as power boats and hence, some restriction of recreational uses of Talbot Lake will occur.

F11837
SHINDLER DB * **Le role de la biologie dans le Programme de surveillance administre par la**

Direction de la qualite des eaux * 7p * Environ Can, Dir gen eaux inter, Dir qual eaux * 1981-04.

La Direction de la qualite des eaux est chargee de produire des donnees et de l'information interpretative sur la qualite des eaux interieures qui relevent de l'administration federale. Depuis sa creation, la Direction s'est toujours efforcee de modifier son programme et d'adopter de nouvelles techniques propres a donner des resultats tangibles, au fur et a mesure qu'on cernait de nouveaux problemes dans le milieu aquatique. Bien que le premier objectif de son programme de surveillance consists a prendre des mesures physico-chimiques de l'eau, la Direction a toujours tente d'obtenir des donnees de la plus grande utilite en echantillonnant les milieux aquatiques les plus appropries et en employant les techniques qui offrent le meilleure rapport cout-efficacite. Dans le but de s'attaquer aux problemes de contamination et de degradation de l'environnement, la Direction doit continuer a employer certaines techniques biologiques choisies de facon a completer les mesures chimiques et a ameliorer les evaluations de la qualite des eaux. Depuis l'introduction des techniques biologiques, on s'inquiete du fait que le programme de "surveillance biologique" est tout nouveau et, par consequent, qu'il exigera des ressources supplementaires considerables. Toutefois, la Direction n'administre qu'un seul programme de controle; ainsi l'echantillonnage et l'analyse des biotopes ne representent, entre autres, qu'une des nombreuses activites liees a ce programme. En outre, si l'on tient compte du rapport cout-efficacite, que l'on fait une utilisation judicieuse des installations locales et qu'on a recours aux experts de la region, on reduira au minimum les besoins en ressources supplementaires. On ne s'attend pas que la redistribution necessaires des ressources a l'application selective des techniques biologiques augmentera le cout global du programme; on procedera plutot a des echanges a l'interieur du programme (p.ex. efficacite accrue grace a la simplification de l'echantillonnage et a l'automatisation des analyses) sans toutefois compromettre les activites fondamentales de surveillance physico-chimique de la Direction. La gestion adequate de son programme biologique permettrra a la Direction de relever le defi des &nnees 80.

065593
SHIVALINGAIAH B * **Background review atmospheric fallout and stormwater quality in Hamilton** (see chapter 4.3 for complete reference - voir chapitre 4.3 pour la reference complete)

065592
SHIVALINGAIAH B, WILLIAM J * **Atmospheric pollution in relation to storm water quality modelling: literature review for an industrial city** (see chapter 4.3 for complete reference - voir chapitre 4.3 pour la reference complete)

061983
SINGER SN * **Evaluation of impacts of storm water runoff and combined sewer overflows on receiving waters, an assessment procedure** * 46p * Ont Minist Environ * 1982-04.

Water quality characteristics of urban surface runoff and combined sewer overflows eventually emptying into some receiving body of water, are described, with emphasis on their contribution to the total pollution load. The impacts of pollutant loadings carried by stormwater runoff and combined sewer overflows onto receiving waters are discussed under such water quality parameters as oxygen demanding materials, suspended solids and associated contaminants, nutrients, heavy metals, and bacteria. It is shown that the question of impact is an issue which is affected by local specific conditions and therefore proper evaluation requires individual examination on a city-by-city basis. Four levels of assessment techniques of the impacts are described: 1) preliminary planning procedures; 2) STORM model coupled with a steady state dissolved oxygen model to evaluate the quantity and quality of urban runoff; 3) STORM model coupled with a dynamic water quality model; and 4) SWMM model, a comprehensive mathematical model, capable of representing urban stormwater runoff.

064399
SLADECEK V (ED) * **International Association of Theoretical and Applied Limnology, Proceedings, Vol 21, Japan, 1980** (see chapter 4.4 for complete reference - voir chapitre 4.4 pour la reference complete)

066854
SLOTERDIJK H * **Bacteriological survey of the St Francois River on the Quebec-Maine border; July 1981, preliminary report** * 9p * 1981-11.

Results of an intensive bacteriological survey during August 1981 on the Quebec-Maine stretch of the St Francois River, are presented. Physical parameters measured included pH, colour, turbidity, total suspended solids, conductivity and hardness, while chemical parameters included ammonia, nitrite-nitrate, total phosphorus, inorganic phosphorus and total organic carbon. Biological parameters measured were total coliforms, fecal coliforms and fecal streptococci, as well as the potential fertility and toxicity index as measured by an algal bioassay. Analytical results for the chemical parameters studied did not indicate a

highly polluted river but results of bacteriological analyses showed that the river was highly contaminated by fecal matter. Three significant sources of domestic effluents were identified on the international section of the St Francois River between Lake Pohenegamook and Lake Beau.

063630
SLY PG * **Sedimentology and geochemistry of recent sediments off the mouth of the Niagara River, Lake Ontario** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

062359
SMITH JN, ELLIS KM * **Transport mechanism for Pb-210, Cs-137 and Pu fallout radionuclides through fluvial-marine systems** * Geochim Cosmochim Acta * 46(6) 941-954 * 1982-06.

Pb-210, Cs-137 and Pu-239,240 sediment-depth profiles in an anoxic, unbioturbated, estuarine depositional regime at the head of the Saguenay Fjord, Que. exhibit a seasonally-modulated component caused by pulsed inputs of silts and sands during high energy, spring river discharge events superimposed on an ambient depositional pattern of finer grained clays and organic matter. A precise sediment time-discharge during the period, 1963-1976. The historical record of Cs-137 and Pu-239,240 sediment fluxes has been reconstructed through the normalization of fallout radionuclide activities to the excess Pb-210 activity profile. Radionuclide flux geochronologies have been interpreted on the basis of a fluvial-marine transport model which distinguishes between inputs due to direct adsorption of radionuclides onto particles in the water column and inputs resulting from the erosion of particle-associated radionuclides from the drainage basin. Rate constants corresponding to residence times of one year for Cs-137 and Pu-239,240 in the water column and 15000 years for each radionuclide in the drainage basin provide reasonable agreement between the model and experimental results, although there is some evidence for a slightly longer drainage basin residence time for plutonium. Both the threshold for the initial appearance of Pu-238, derived from the atmospheric burnup of a SNAP-9A satellite reactor in 1964, and the magnitude of its isotopic dilution by drainage basin inputs of Pu-239,240 are also in agreement with model predictions.

062790
SMITH JN, LORING DH * **Geochronology for mercury pollution in the sediments of the Saguenay Fjord, Quebec** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

065474
SMOL JP, BROWN SR, MCNEELY RN * **Cultural disturbances and trophic history of a small meromictic lake from central Canada** * Hydrobiologia * v103 125-130 * 1983-07-01.

The recent history of Little Round Lake, a small meromictic lake in southeastern Ontario, is considered. Pollen analyses were used to identify past changes in terrestrial vegetation, whilst limnological conditions were interpreted on the basis of diatom and chrysophyte microfossils. Contemporaneous with the arrival of European settlers (ca. A.D. 1850), the predisturbance assemblage of oligotrophic Cyclotella diatoms was replaced by Synedra spp., which then succeeded to a eutrophic flora dominated by Stephanodiscus hantzschii. Meanwhile, synuracean algae were almost completely excluded. Over the last 30 years, the algal microfossils indicate that the lake underwent a marked return to oligotrophy. Evidence is presented which suggests that this shift was related to the cultural enhancement of meromixis by the seepage of road salt.

065361
SNODGRASS WJ, HOLLORAN MF * **Sensitivity analysis of reservoir oxygen model** * Can Water Resour J * 8(3) 1-25 * 1983.

A sensitivity analysis of an oxygen model developed for reservoirs is presented. The model's predictions for temperature show good agreement with observations on a reservoir whose vertical mixing is controlled by inflow-outflow differences, summer stratification and autumnal overturn. Model predictions of hypolimnetic oxygen are most sensitive to sediment oxygen demand. They are moderately sensitive to land-based inputs of BOD, solar ratiation and wind speed. Lack of model sensitivity to the reaeration coefficient suggests an inadequacy in the model's description of vertical mixing during spring heating. The model is relatively insensitive to such hydraulic parameters as withdrawal thickness of the outflow jet. These results suggest criteria for engineering design and siting reservoirs and for priorities for experimental and field measurements of model parameters.

062915
SONZOGNI WC, RICHARDSON W, RODGERS P, MONTEITH TJ * **Chloride pollution of the Great Lakes** * J Wat Poll Control Fed * 55(5) 513-521 * 1983-05.

Chloride has long been used as an indicator of pollution in the Great Lakes, one of the largest and most valuable fresh-water resources in the world. Marked increases in chloride concentrations since the early 1900s, which are considered symptomatic of a variety of cultural impacts, were a major impetus for the multi-billion-dollar Great Lakes pollution abatement programs instituted during the

1970s. More recently, chloride and other conservative ions have been implicated as pollutants, based on their possible roles in changing the assemblages and distributions of algae and other organisms in the lakes. Current concern over chloride is exemplified by a recent conference held to cultivate a 5-year U.S. plan for Great Lakes research and development. Chloride discharges were identified as one of several major problems worthy of special attention. This paper summarizes current estimates of chloride inputs to the Great Lakes from various sources. It also evaluates changes that have occurred. Future chloride levels are projected with the aid of a mathematical model that treats the lakes as an integrated system. Management implications of current and future chloride inputs in the lakes are discussed. Particular attention is given to Lake Michigan, especially with regard to modeling its response to chloride inputs.

065183
SOPUCK VJ, LEHTO DAW, SCHREINER BT, SMITH JWJ * **Interpretation of reconnaissance lake sediment data in the Precambrian Shield area, Saskatchewan** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

064542
SOROKA IK, MACKENZIE-GRIEVE G * **A biological and water quality assessment at a placer mine on Little Gold Creek, Yukon Territory** * Reg Program Rep No 83-06 * 105p * Environ Prot Serv, Pac Reg, Yukon Branch, Environ Can * 1983-05.

An assessment of water quality and biological conditions at a placer gold mine site on Little Gold Creek was carried out during the period June to September, 1982. The water quality, sediment and bottom fauna characteristics were documented at five sample stations. Water quality parameters were seen to be dramatically influenced by activity at the placer mine. During periods of sluicing activity elevated values were observed at downstream stations for suspended sediments (NFR), settleable solids, filterable residue, turbidity, and the extractable heavy metals. Dissolved oxygen levels and pH values were lower at downstream locations during sluicing. Sediment composition of the stream bottom was seen to increase in percent of fine sands, silts and at downstream locations during sluicing. These fine sediments were seen to have lower extractable heavy metal values than the more coarse sediments of the control station. This was attributed to the larger, and heavier metal bearing particles being deposited in the settling pond system. Stream bottom composition was observed to return to a composition more typical of the control station after extended periods of no sluicing activity. Bottom fauna abundance and diversity was determined. Diversity indices indicate that stations subjected to the influence of the placer mine activity has lower diversity and fewer organisms than the control. The composition of benthic invertebrates changed from a community dominated by members of the Ephemeroptera and Plecoptera at the control station to a community dominated by members of the Diptera at stations subject to the influence of the placer mining activity.

065044
SOROKIN YI * **Hydrogen sulfide formation in Volga reservoirs and its effect on their oxygen regime** * Can Transl Fish Aquat Sci 5028 * 11p * Fish Oceans Can, SIPB * 1983.

In studies of hydrogen sulphide formation in large Volga reservoirs, conditions were encountered that differ markedly from those arising in the first few months, or even years, following the flooding of soils in small reservoirs or experimental tanks. The present work examines hydrogen sulphide formation from the reduction of sulphites in bed soils in the Rybinsk, Gorki and Kuibyshev reservoirs.

F10747
SPEAR PA * **Le zinc dans l'environnement aquatique: chimie, repartition et toxicologie** * CNRC no 17590 * 152p * Cons natl rech Can, Ottawa, Ont * 1981.

Le zinc, dont le Canada est le plus grand producteur du monde et le troisieme quant au raffinage de cet element, s'emploie de maintes facons tres diverses, par exemple pour galvaniser le fer et l'acier ainsi que pour le traitement medical des infections de la peau. Bien que les menaces a la survivance des organismes soient rares par les concentrations du zinc trouvees dans la nature, les activites de l'homme peuvent avoir une mauvaise influence sur les ecosystemes marins et d'eau douce en y creant des concentrations toxiques du zinc. Les problemes d'environnement ainsi crees par la liberation du zinc provenant des sources industrielles et urbaines ont ete etudies de pres par les chercheurs du pays, depuis des dizaines d'annees deja. Le Sous-comite de l'eau, qui fait partie de Comite associe du CNRC sur les criteres scientifiques concernant l'etat de l'environnement, a evalue les donnees scientifiques disponibles sur les rapports cause-effet du zinc dans l'environnement aquatique. L'auteur du rapport etudie notamment: (1) l'importance de la caracterisation chimique du zinc par rapport a la toxicite; (2) les problemes relatifs aux depots acides dans les lacs et les rivieres; (3) les seuils des effets toxiques; (4) un modele generalise pour etudier la dynamique du zinc. L'auteur a evalue les concepts utilises actuellement et a indique les aspects de la pollution par le zinc qui doivent etre mieux etudies et identifies. Par exemple, puisque l'exposition

au zinc dans la nourriture n'est pas suffisamment connue, l'on ne saurait evaluer la toxicite dans de nombreuses communautes aquatiques exposees aux concentrations de plus en plus fortes de cet element.

064928
STANLEY ASSOC ENG LTD * **Slave River Hydro Feasibility Study, Task Area 4B, Surface water quality of the Peace - Athabasca Delta** (see chapter 4.13 for complete reference - voir chapitre 4.13 pour la reference complete)

061902
STEINHART CE, SCHIEROW L-J, SONZOGNI WC * **An environmental quality index for the Great Lakes** * Water Resour Bull * 18(6) 1025-1031 * 1982-12.

To facilitate communication on the environmental quality of lakes, particularly among policy makers and the general public, a new index for summarizing technical information is presented. The index is designed for the nearshore waters of the North American Great Lakes, but the concept is applicable to other temperate lakes with relatively good water quality. The index is based on nine physical (P), chemical (C), biological (B), and toxic substance (T) variables. Raw data are converted to subindex values by mathematically defined functions based on national or international objectives. Subindex values are multipled by weighting factors and added to yield a final score ranging from 0, worst quality, to 100, highest quality. Letters with subscripts following the index score indicate the types and numbers of variables whose values are equal to or worse than the objective - e.g., 70 C1P1 indicates that one chemical and one physical variable exceeded the objective. For 18 nearshore locations in the Great Lakes, index scores ranged from 98 at two stations in Lake Superior to 30C2P1B2T3 off Point Mouillee in Lake Erie. If properly utilized, the index should be a useful tool to help managers evaluate the response of the Great Lakes to the multibillion dollar cleanup efforts conducted during the 1970's.

064300
STEPHENS K, BRANDSTAETTER RJ * **A laboratory manual, collected methods for the analysis of water** * Can Tech Rep Fish Aquat Sci no 1159 * 72p * Dep Fish Oceans, Pac Biol Stn, Nanaimo, BC * 1983-03.

Methods for the collection, preparation and preservation of water samples and their subsequent chemical analysis are described. The work is carried out to support the program of the Lake Enrichment Group to identify suitable lakes for chemical fertilization and to assess the response of lakes to fertilization.

066504
STRACHAN WMJ * **Examination of exposure models in assessment of toxic chemicals** , IN: Proc 9th Annu Aquatic Toxicity Workshop, 1-5 Nov 1982, Edmonton, Alta * MACKAY WC * Can Tech Rep Fish Aquat Sci 1163 * 196-193 * Fish Oceans Can, Fish Habitat Manage Branch, Ottawa, Ont K1A 0E6 * 1983-11.

Risk/hazard assessment for chemicals involves two essential aspects -- exposure and effects (toxicology) -- and a comparison of the levels for each. A number of computational models exist for evaluating the exposure of a chemical in the different compartments of a variety of ecosystems. Input for such estimations includes physical-chemical properties and degradation rates. These are used to predict relative concentrations in air, soil, water, sediments, suspended soil, biota (fish) and could be expanded to provide for terrestrial biota as well. The paper discusses several existing models (EXAMS, Mackay FIGACITY', NRC's PERSISTENCE) and compares these input parameters. The need to standardize these parameters before comparing the models is stressed.

063405
STRONACH JA * **The Fraser River plume, Strait of Georgia** * Ocean Manage * 6(2,3) 201-221 * Amsterdam, NL * 1981-01.

The Fraser River plume is the brackish surface layer formed when the Fraser River discharges into the Strait of Georgia. River discharge varies seasonally from 1000 cu m/second to 10,000 cu m/second, and is also tidally modulated. As the river water spreads out over the Strait, its motion is strongly affected by winds and tides, and the geometry of the river mouth area; there are shallow drying banks along one side of the river mouth, and a solid jetty along the other. The plume thickness varies between 0 and 10 m; the salinity varies from 0 per mil to that of the water beneath it (approx. 28 per mil), and the vertical shear is as much as 1 m sec/m. There is frequently a strong frontal structure associated with the plume, separating it from the more saline water of the Strait. Representative field observations documenting the above conclusions are presented (CTD profiles, current profiles, and satellite imagery). In addition, a numerical model of the plume is discussed, as well as the strategy for calibrating and verifying this model. The numerical model was used to study and predict surface currents, and was also used to produce the upper layer of a two-layer model of the estuarine circulation in the Strait of Georgia (with the lower-layer currents and pressure gradients assumed to be those of a barotropic tidal model).

062463
SUBRAMANIAN KS, LEUNG PC, MERANGER JC * **Determination of arsenic (III,V, total) in polluted waters by graphite furnace atomic absorption spectrometry and anodic stripping voltammetry** * Int J Environ Anal Chem * 11(2) 121-130 * 1982-04.

An ammonium pyrrolidinedithiocarbamate-methyl isobutyl ketone-electrothermal atomic absorption spectrophotometric (APDC-MIBK-ETA) procedure and a toluene extraction-anodic stripping voltammetric (ASV) procedure were applied for the determination of As(III,V,Total) in some polluted waters. The total arsenic content of these water samples was also determined using the direct ETA and the nickel-matrix modification-ETA methods. There was good agreement among the various methods on the total arsenic content of the water samples. Neither the container material (Pyrex glass or linear polyethylene), nor filtration, nor preservation with 1% HCl had any significant effect on the total arsenic concentration of the polluted river water and mine leachate samples studied. Also, no As(III) could be detected in the samples.

064523
SWAIN LG * **Fraser River estuary study water quality, industrial effluents** * 195p * Prov BC, Gov Can, Victoria, BC * 1980-12.

A review of industrial wastewater effluents discharged directly to the Fraser and Serpentine Rivers within the Fraser River Estuary study area, over the period 1970 to 1978, was undertaken. Each industrial sector was addressed from the viewpoint of relevant guidelines, objectives, or regulations and applicable wastewater treatment technology. Individual operations within an industrial sector were assessed according to their pollution control permits, monitoring data related to their discharges, and the relationship between individual discharges in the same industrial sector. Many of the assessments were made on the basis of very few data. Operations within the forest and food industries, exclusive of fish processing operations, are generally required to meet level "A" objectives of the Pollution Control Board. Suspended solids loadings to the study area from the food industry could be reduced between 60% and 90% if effluents from fish processsing operations met level "A" of the objectives. Domestic sewage discharges from industry and small operations are required to meet level "AA" of the objectives. Many metal finishing and fabricating operations do not meet level "C" of the objectives. Some metal loadings from metal finishing and fabricating operations could be reduced by 95% if level "C" of the objectives was met. Bioassay monitoring is required for effluents from the forest, food, metal finishing and fabricating, and concrete industries, as well as from certain other specified operations. This monitoring should include adequate background chemical analyses. Other required monitoring programs include mercury analyses of effluents at the forest, food, and metal finishing and fabricating industries; nutrient analyses of effluents from all forest and food operations; analyses of all effluents from the concrete industry and some specified forest industry operations for certain heavy metals; as well as analyses of effluents from forest industry and wood preservation operations for chlorinated phenolic compounds. A special study has been recommended to determine any improvements in ground and surface waters if pH is controlled in exfiltration ponds at metal finishing operations.

063473
TAN FC, STRAIN PM * **Sources, sinks and distribution of organic carbon in the St. Lawrence Estuary, Canada** * Geochim Cosmochim Acta * v47 125-132 * 1983.

Carbon isotope ratio analysis of particulate, planktonic and sedimentary organic carbon and dissolved inorganic carbon has been used to study the sources and sinks of the organic carbon in the St. Lawrence Estuary and the Gulf of St. Lawrence, Canada. Particulate organic carbon (POC) isotope ratios in the upper St. Lawrence Estuary are uniform and indistinguishable from those of POC in the St. Lawrence River and of planktonic organic carbon in both areas. An examination of carbon isotope ratio differences between the planktonic and dissolved inorganic carbon reservoirs shows that this difference varies significantly and somewhat unpredictably between sectors of the study area. Interpretation of environmental carbon isotope data on the basis of an assumed constant fractionation factor may be subject to large errors. Direct measurement of both reservoirs is preferable.

063687
TANNER JW * **Nanticoke water chemistry 1979** * 15p * Ont Minist Environ * 1981-01.

The 1979 ice-free season was the eleventh of uninterrupted water chemistry monitoring in the Nanticoke area of Lake Erie. The purpose of the 1979 program was to continue monitoring the parameters studied in the past; however, fewer stations were sampled. This is a report of the 1979 data and of the results of statistical analysis of those data. Implications of these results for the environment of Nanticoke will be discussed in a Nanticoke Integrated Report, which the Ministry of the Environment and the Ministry of Natural Resources are preparing.

062342
TARAPCHAK SJ, BIGELOW SM, RUBITSCHUN C * **Soluble reactive phosphorus measurements in Lake Michigan: filtration artifacts** * J Great Lakes Res * 8(3) 550-557 * 1982.

Tests bases on variations in vacuum pressure, volume of sample filtered, and filter pore size demonstrate that filtration artifacts seriously bias estimates of soluble reactive phosphorus (SRP) in water from Lake Michigan. Variations in vacuum pressure and filter pore size bias estimates by approximately 100%, and variations in sample volume alone can produce nearly a twofold difference in SRP values. These biases are caused by differences in the relative amounts of molydate-reactive PO4-P released from particulate material and by the retention of P-containing "particles" by filters as pores clog with debris and are partially responsible for method-specific differences in SRP estimation. Vacuum pressures less than or equal to 300 mm Hg, small sample volumes (less than or equal to 100 mL), and filters of the same type and pore size should be used for routine SRP estimation.

062331
TARAPCHAK SJ, CHAMBERS RL, BIGELOW SM * **Soluble reactive phosphorus measurements in Lake Michigan: causes of method-specific differences** * J Great Lakes Res * 8(4) 700-710 * 1982.

Method-specific differences in soluble reactive phosphorus (SRP) determinations are thought to be caused in part by differences in acid strengths and exposure times. This premise was tested by comparing SRP concentrations measured in water from Lake Michigan and the Grand River by three methods differing in acid strength, exposure time, and molybdate concentration. Although longer exposure times often result in higher SRP values, more PO4-P can be released from bound sources in lake water with 0.16 N HCl than with 0.4 N HCl. Method-specific differences in SRP values, therefore, rarely are proportional to differences in acid strength or exposure time and will vary with changes in the chemical composition of the SRP pool.

066849
TASK FORCE ON ECOLOGICAL EFFECTS ON NON-PHOSPHATE DETERGENT BUILDERS * **Ecological effects of non-phosphate detergent builders, final report on inorganic builders** * 41p * Int Jt Comm, Great Lakes Reg Off, 100 Ouellette Ave, Windsor, Ont N9A 6T3 * 1983-11.

This report, the third and final in a series on ecological effects of non-phosphate detergent builders, deals with the inorganic substances - carbonates, silicates and aluminosilicates. The environmental effects of alternative materials used by detergent manufacturers because of restrictions on detergent phosphates are examined in the areas of aquatic chemistry, microbial degradation, wastewater manzgement, biological effects, and eutrophication. It is concluded that the use of sodium carbonate, sodium silicate and Type A sodium zeolite, is ecologically acceptable. Terms of reference and a membership list of the Task Force on Ecological Effects of Non-Phosphate Detergent Builders, are included in the appendix.

062021
TAYLOR GJ, CROWDER AA * **Accumulation of atmospherically deposited metals in wetland soils of Sudbury, Ontario** (see chapter 4.9 for complete reference - voir chapitre 4.9 pour la reference complete)

F12181
TAYLOR MC, DEMAYO A, REEDER S * **Lignes directrices concernant la qualite des eaux de surface, Vol. 1 Les substances chimiques inorganiques, l'argent** * 15p * Environ Can, Dir gen eaux inter, Dir qual eaux, Ottawa, Ont * 1983.

On a effectue une etude de la documentation portant sur les effets toxiques de l'argent et de composes de l'argent sur les humains, les organismes aquatiques, les plantes et le betail. Ces donnees sont resumees dans cette publication. En se basant sur ces donnees, on propose des valeurs des teneurs maximales en argent dans l'eau auxquelles on n'observe pas d'effets toxiques.

F12177
TAYLOR MC, DEMAYO A, REEDER SW * **Lignes directrices concernant la qualite des eaux de surface, Vol. 1 Les substances chimiques inorganiques, le nickel** * 13p * Environ Can, Dir gen eaux inter, Dir qual eaux, Ottawa, Ont * 1983.

On a effectue une etude de la documentation portant sur les effets toxiques du nickel et de composes du nickel sur les humains, les organismes aquatiques, les plantes et le betail. Ces donnees sont resumees dans cette publication. En se basant sur ces donnees, on propose des valeurs des teneurs maximales en nickel dans l'eau auxquelles on n'observe pas d'effets toxiques.

F12176
TAYLOR MC, REEDER SW, DEMAYO A * **Lignes directrices concernant la qualite des eaux de surface, Vol. 1 Les substances chimiques inorganiques, le chrome** * 9p * Environ Can, Dir gen eaux inter, Dir qual eaux, Ottawa, Ont * 1982.

On a etudie la documentation portant sur les effets toxiques du chrome et des composes du chrome sur les humains, les organismes aquatiques, les plantes et le betail. L'information recueillie figure dans le present rapport. En s'appuyant sur cette information, on propose des concentrations maximales de chrome dans l'eau, en deca desquelles on n'observe aucun effet toxique.

065122
TELANG SA, HODGSON GW * **Fate of oxygen and refractory organics in Marmot basin streams: seasonal variations** * J Environ Qual * 12(4) 575-579 * 1983-10.

A conceptual process reactor model with input-output functions developed for the mountain streams of the Marmot Basin (Alberta, Canada) showed seasonal trends in the conversion of organic matter. Based on mass balance data, organic compounds (e.g., tannins and lignins), and total organic C showed net gains in the stream waters in winter; in spring, the compounds tend to be depleted in waters; in the fall, humics and tannins and lignins underwent net depletion. The indicated changes of accumulation and depletion ranged from +95 to -42% of incoming mass. The chemical O2 demand showed gains in the stream waters throughout the season. The biological O2 demand showed little change throughout the seasons. Photochemical processes appeared to be important processes in the conversion of organic matter in clear, cold mountain streams of the Marmot Basin. Biological uptake of refractory compounds appeared to be a minor process.

065481
TELANG SA, HODGSON GW * **Fate of organic compounds in mountain streams of the Marmot basin: a process reactor model** * Hydrobiologia * 98(2) 185-191 * 1983-01-23.

Clear cold mountain streams of the Marmot Creek drainage basin are surprisingly active in the conversion of organic matter. A conceptual process reactor model with input/output functions was developed for the Marmot basin to evaluate the stream as a reactor and to quantify many of the processes within the process reactor of the stream. The flow of refractory organic compounds through a 2 km reach of the Marmot Creek basin showed no conversion, just simple transport from input to output, for humic and fulvic acids. Tannins and lignins, which are commonly regarded as less refractory, showed conversions. Mass balance data for the input/output flow of more labile substances-animo acids, carbohydrates, fatty acids and phenols-confirmed the processes of degradation. Further, they showed a great deal of dynamic activity in the stream that resulted in some cases in net generation of labile compounds such as hydrocarbons, i.e. where processes of generation dominated those of degradation.

064562
TELANG SA, KORCHINSKI M, HODGSON GW * **Abundances and transport of ions, nitrogen, and carbon in the Mackenzie River** * SCOPE/UNEP Sonderband Heft J2 * (52) 333-346 * Mitt Geol-Palaontol Inst, Univ Hamburg, DE * 1982-05.

Detailed hydrogeochemical investigations were carried out in the Mackenzie River. Preliminary results suggest that the major ions transported by the river to the Beaufort Sea are calcium, bicarbonate and sulphate. Total dissolved nitrogen runs to 0.13 x 10 sup 16 kg/day. The transport of total dissolved carbon amounts to 32 x 10 sup 6 kg/day of which 75% is in the form of inorganic carbon and the rest is organic in nature. Detailed examination of the dissolved organic carbon sheds light on biogeochemical processes related to the decomposition of organic matter in the river system.

065823
THOMANN RV, DI TORO DM * **Physico-chemical model of toxic substances in the Great Lakes** * J Great Lakes Res * 9(4) 474-496 * 1983.

A physico-chemical model of the fate of toxic substances in the Great Lakes is constructed from mass balance principles, incorporating principal mechanisms of particulate sorption-desorption, sediment-water and atmosphere-water interactions, and chemical and biochemical decay. The steady state mass balance model of the suspended solids in the open lake water yields net solids loss rates from 0.02 m/d for Saginaw Bay to 1.22 m/d for Lake Ontario. Calibration of the toxic model is through comparison to plutonium-239 data collected in the 1970s using a 23-year time variable calculation. The results indicate that, in general, the sediments are interactive with the water column in the Great Lakes through resuspension and horizontal transport. Fifty percent response times of 239Pu following a cessation of load extend beyond 10 years with sediment resuspension. The calibrated model was also applied to polychlorinated biphenyl (PCB) using a high and low estimate of contemporary external load and with and without volatilization. The lower load level (lake range 640 to 1,390 kg/yr) with volatilization (at an exchange rate of 0.1 m/d) appears to be more representative of observed surface sediment data for the open lake waters. Calculated water column concentrations for the lower load level with and without volatilization ranged from 0.25 to 0.90 ng/L for open lake waters. Fifty percent response times for PCB following cessation of load varied from less than 5 years when volatilization was included to 10 to 20 years without volatilization. Comparison of these response times to decline of concentrations of PCB in Lake Michigan bloaters indicate that, at least for that lake, volatilization is occurring at an exchange rate of about 0.1 m/d.

063998
THOMANN RV, DI TORO DM, SCAVIA D, ROBERTSON A * **Ecosystem and water quality modeling** . IN: IFYGL - The International Field Year for the Great Lakes * AUBERT EJ, Richards TL * 353-366 * Natl Oceanic Atmos Adm, Great Lakes Environ

Res Lab, US Dep Commer, Ann Arbor, MI 48104 US * 1981-03.

Water quality and ecosystem models developed during the International Field Year for the Great Lakes, are described. A discussion of mathematical models in general is presented and it is demonstrated that a model of the water quality of Lake Ontario is a synthesis of meteorological and hydrological, hydrodynamic, biological and chemical phenomena, achieved by applying the basic principle of mass conservation, expressed through one or more equations that incorporate the essence of each of the key phenomena. Principal features of the three components in equations for the models of Lake Ontario, namely transport, kinetics and inputs, are described. The accomplishments of models developed during the Field Year are reviewed to aid ecological understanding and planning and management within the Lake Ontario watershed. Information on carbon flow, turnover times, control of productivity, factors affecting nutrient dynamics, hydrodynamic transport effects, vertical distributions, population growth rates, and settling velocities, are extracted from the data.

062998
THOMAS DJ * **Water quality measurements and dredge spoil monitoring at McKinley Bay, N.W.T.** * vp * Arct Lab Ltd, Inuvik, NWT * 1980

In accordance with the requirements of Dome Petroleum's Ocean Dumping permit, water quality measurements (dissolved oxygen, temperature, salinity and water transperancy) were conducted at 5 monitoring stations on four occasions at McKinley Bay, N.W.T., during 1980 dredging operations. No significant effects on the water quality of the parameters listed above could be related to dredging in McKinley Bay. The distributions of all measured parameters were generally similar for the station nearest to active dredging and the four background stations. Routine chemical analyses were also performed on dredge spoil samples. The heavy metal content was variable: except for Hg in one sample (290 ng/g sediment), all values fell within the range of values accepted for average uncontaminated world coastal sediments. The exceptional mercury concentration was, however, still below the Ocean Dumping Control Act regulated limit of 750 ng Hg/g solid. Total organic carbon content and extractable oil and grease ranged from 0.09 to 8.65% and 45-2120 ppm by weight respectively. Oxygen uptake rates were low having a range of 0.031 to 0.268 mL O2/g sediment/day.

063628
THOMAS RL * **Lake Ontario sediments as indicators of the Niagara River as a primary source of contaminants** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

065697
THOMPSON ME * **Sulfur yields of Quebec rivers** * Natl Water Res Inst Unpublished Manuscr #83-22 * vp * Environ Can, Natl Water Res Inst, Inland Waters Dir * 1983-06.

The long term average sulfur-yields of rivers in southern Quebec have been calculated using mean sulfate concentrations times runoff for gauged rivers. The areal distribution of sulfur-yields agrees well with the known pattern of atmospheric wet deposition. In heavily populated areas, however, especially in the St. Lawrence Lowlands, there is considerably more sulfur than can be attributed to wet deposition.

066653
THOMPSON ME * **Factor analysis applied to water chemistry data: its usefulness and limitations** * NWRI Manuscr Rep No 83-19 * 25p * Environ Can, Natl Water Res Inst, Inland Waters Dir * 1983-04.

Results of factor analysis applied to data for rivers, lakes, and precipitation chemistry are presented. The major factors affecting the chemistry of surface waters are seasalt (near the coast), chemical weathering, and acidic precipitation. Similarly, the major factors affecting precipitation chemistry are seasalt (near the coast), acidic precipitation, and continental dust. Factor analysis is useful for displaying relationships within a data set, and can be used as an aid to understanding the sources of variation in complex environmental problems. However, precise quantitative significance should not be ascribed to the factor loadings, because the values obtained are so sensitive to the choice of variables and of method of factoring and of rotation of the factor matrix.

062294
THOMSON L * **Cottage-plan threatens Winnipeg's water supply** (see chapter 4.11 for complete reference - voir chapitre 4.11 pour la reference complete)

061984
TOXICITY UNIT STAFF, ONT MINIST ENVIRON, LIMNOL TOXICITY SECT, WATER RESOUR BRANCH * **Toxicity of industrial effluents in Ontario, January 1969 to December 1980** * vp * Ont Minist Environ, Water Resour Branch, Box 213, Rexdale, Ont M9W 5L1 * (1981).

This publication contains a record of waterborne industrial waste quality across Ontario compiled to provide a background for current effluent conditions. Data were compiled from bioassay tests from January 1969 - December 1979 and the review was designed to

assist pollution abatement staff compare industrial waste quality through time and within similar industrial groups. Information is presented in two sections: 1) Industry Description Sheets identify company name, location, receiving water, background history, production output, effluent flow rate, chemistry, and comments; 2) Bioassay Data Summary Sheets identify company name, location, discharge, test number, sample date, static 96 hour LC sub 50 data, continuous flow 96 hour LC sub 50 data, and comments. Both sections list the industries alphabetically by name. All industries are listed in three indexes for easy cross reference: Index I - by region; Index II - by process type; and Index III - by lethality for each region. Fundamental elements of the short term bioassay used for monitoring and controlling discharges to the aquatic environment, are described.

062014
TRACY BL, PRANTL FA * **25 years of fission product input to lakes Superior and Huron** * Water Air Soil Pollut * 19(1) 15-27 * 1983-01.

To assess the health significance of fission products in the upper Great Lakes, we have reviewed available data from 1963 to 1980 on 90Sr, 125Sb, 137Cs, and 144Ce concentrations in the water, sediments, and biota of Lakes Superior and Huron. Activities in water and sediment were compared with predictions based on fallout deposition over the past 25 yr. Estimates have also been derived of the removal half-times of the various fission products from lake water. There are indictions that 137Cs is re-entering water from sediment. The significance of the various pathways of fission products from the upper lakes system to man has been evaluated. The dose commitments from fission product concentrations over the past 25 yr give no basis for health concern. However, a large-scale release from a nuclear facility on the shore of a lake could have a measurable impact for many years to come.

065101
TREW DO * **An approach for assessing the impact of lake level fluctuations on lake trophic status, Cold Lake - Beaver River Basin** (see chapter 4.5 for complete reference - voir chapitre 4.5 pour la reference complete)

065095
TREW DO, YONGE EI, KAMINISKI RP * **A trophic assessment of nine lakes in the Cold Lake region, interim report** * 70p * Alta Environ, Pollut Control Div * 1981-11.

This investigation, constituting a baseline assessment of nine lakes in the Cold Lake region, Alberta, served to: define existing trophic states of the major recreational lakes of the region; generate estimates of their individual phosphorus loadings so that predictive statements regarding the potential impacts of watershed disturbances could be made; and, establish baseline chemical data. An incubation technique is devised to provide for improved lake to lake comparability of productivity measurements. Productivity data, as determined by the radiocarbon uptake method, are correlated with standing crop observations and the two combined to determine a mean photosynthetic index for each lake, useful in demonstrating the potential interaction of phosphorus and nitrogen in phytoplankton carbon fixation in these lakes. Whole-lake chlorophyll surveys were conducted on four lakes to quantify phytoplankton spatial heterogeneity at the community level. The problem of defining accurate total phosphorus loadings when internal vectors are present is addressed by monitoring hypolimnetic phosphorus buildup in Ethel Lake.

064243
TRUDELL MR * **Assessment of reclamation potential and hydrologic impact of large-scale surface mining of coal in plains areas of Alberta: summary report of activities 1982-83, Appendix S, Characterization of surface water and evaluation of contamination by spoil groundwater discharge at the Battle River Site** * 18p * (Alta Res Counc) * 1983-02.

This report deals with two distinct components of the relationship between surface water, primarily streams, and surface mining at the Battle River site. More specifically, it investigates the potential for the quality of stream water in the Battle River area to be degraded as a result of mining. The first section of this report is a characterization of existing surface water quality, including comparisons between gauging stations upstream and downstream from the mining sites. This section establishes a base-line against which changes in water quality as a result of mining may be monitored. The second section is an evaluation of the potential for streams in the Battle River area to be affected by groundwater discharge from spoil areas. This discharge, in the form of springs, is quantitatively integrated (in terms of flow rates and water quality) to establish the effects of mining on the quality of water in the Battle River.

062917
TURNER JV, FRITZ P * **Enriched 13C composition of interstitial waters in sediments of a freshwater lake** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

065299
TURNER MA, RUDD JWM * **The English-Wabigoon River system: 3. Selenium in lake enclosures: its geochemistry, bioaccumulation, and ability to reduce mercury bioaccumulation** * Can J Fish Aquat Sci * 40(12) 2228-2240 * 1983-12.

Aquatic biota have been shown previously to bioaccumulate selenium rapidly with a concomitant reduction in accumulation of mercury when exposed to 100 micro g Se/L. Using radioisotope techniques this experiment extends these observations by examining the effects of single additions of sodium selenite at 1, 10, and 100 micro g Se/L to experimental ecosystems (130 cubic m) located in mercury-contaminated Clay Lake, northwestern Ontario (50 degrees 03'N, 90 degrees 30'W). The major sink for added selenium and mercury was the sediment movement of 75Se into the sediments in control enclosures (less than 0.2 micro g Se/L) appeared to stabilize within 6 wk; however, movement did not stabilize in the selenium enclosures where selenium remaining in water was largely ionic. At first, selenium accumulated rapidly in net plankton but then declined in correspondence with water concentrations. If not present in excessive amounts, selenium might be of benefit in the treatment of aquatic ecosystems with either atmospheric or point-source mercury pollution problems.

062283
UNNY TE, MCBEAN EA (ED) * **International Symposium on Real-time Operation of Hydrosystems, June 24-26, 1981, University of Waterloo, Waterloo, Ontario, Canada Proceedings, 2 vol.** (see chapter 4.5 for complete reference - voir chapitre 4.5 pour la reference complete)

F12110
VAILLANCOURT G, LAFERRIERE M * **Relation entre la qualite du milieu et les groupements benthiques dans la zone littorale du Saint-Laurent** * Nat can * 110 (4) 385-396 * 1983.

Nous avons etudie le benthos recolte a onze stations du Saint-Laurent en vue de definir les differents gradients de pollution. Le groupement a Bithynia tentaculata et Sparganophilus tamesis est typique des zones littorales propres: celui a Peloscolex ferox et Limnodrilus hoffmeister typique d'un milieu legerement pollue. L'espece eurytope L.hoffmeisteri est omnipresente: en forte densite en milieu pollue sur substrat vasosableux, en faible densite sur substrat sableux. Les indices de diversite et de regularite calcules sur le benthos confirment le degre d'alteration des biotopes definis par l'analyse physico-chimique. L'analyse factorielle des correspondances taxons-stations distingue les stations en fonction de la qualite des biotopes et du benthos qui les colonise.

F11048
VAN COILLIE R, ST-ARNEAULT C * **Physico chimie aquatique des bassins hydrographiques au territoire Grande Baleine (1960-1979)** (see chapter 2 for complete reference - voir chapitre 2 pour la reference complete)

F11778
VANIER D * **Pollution de l'eau** * L'environnement * 9(02) 14-17 * 1982-05.

L'auteur examine le fonctionnement et les resultats du programme d'assainissement des eaux, mis sur pied par le gouvernement du Quebec en 1978. Il compare ce programme au projet francais d'assainissement de 1970, et explique a partir de la situation des usines de chlore-alcali et de la pollution organique humaine d'autres alternatives technologiques utilisees ailleurs dans le monde.

064416
VERDUIN J, MUNAWAR M * **Estimates of open water photosynthesis in the North American Great Lakes** , IN: International Association of Theoretical and Applied Limnology, Proceedings, UP, 1980 * SLADECEK V * 21(3) 1717-1724 * E Schweiz Verlagsbuchhandlung, D-7000 Stuttgart 1, DE * 1981.

Open water data in western Lake Erie is shown to yield photo-synthetic rates about two-fold higher than clear and dark bottle techniques and consequently, it is postulated that the average hourly yield per mg of chlorophyll under optimal light in open water has a value of 0.66 millimoles of CO2 fixed, or O2 produced, and that the average for the euphotic zone is 0.4 millimoles per mg of chlorophyll. An equation for predicting summer mean daily gross photosynthetic yields is derived: Gross photosynthesis (mmol per sq m per day) = 0.4 x chlorophyll a (mg per cu m) x euphotic zone (m) x daylight period (hr). When applied to the North American Great Lakes, mean summer gross photosynthetic yields of about 200 mmol per sq me per day are predicted. It is concluded that computed photosynthetic yields in open offshore waters confirm the predicted high yields and indicate that the low photosynthetic yields per unit chlorophyll a encountered when using 14C-based methods do not reflect the true productivity of lakes.

065218
VONHOF JA * **Hydrogeological and hydrochemical investigation of the waste disposal basin at I.M.C.C. K2 potash plant, Esterhazy, Saskatchewan** * NHRI Pap no 13, IWD Sci Ser no 116 * 203p * Environ Can, Natl Hydrol Res Inst, Inland Waters Dir, Ottawa, Ont * 1983.

Large volumes of both solid and liquid wastes are generated by the potash industry in Saskatchewan. To determine the effect of the waste disposal basins on the groundwater and surface water regime, a study was undertaken

by the Hydrology Research Division, Inland Waters Directorate, from 1968 to 1975, near one of the potash mines: International Minerals and Chemical Corporation (Canada) Ltd. K2 potash plant, Esterhazy, Saskatchewan. The study involved the definition of the hydrogeological and hydrochemical environment and subsequent monitoring of both environments. In addition, detailed studies were conducted on the spatial and temporal variation of the groundwater chemistry and an electric analog model was constructed. Results show that: the waste disposal basin is underlain by a semi-confined buried valley aquifer; electric analog simulations indicate that within 30 years considerable contamination of an area several hundred acres in size, immediately east of the brine could occur; significant temporal variations were found to be present in the groundwater chemistry; sequential sampling of the observation well network shows that at the point of sampling no contamination of the aquifer has occurred.

065736
WAINIO A * **Our tormented rivers** * Seasons * 20(2) 26-31,49 * Fed Ontario Nat, 355 Lesmill Rd, Don Mills, Ont M3B 2W8 * 1980.

Degradation of our waterways began with the pioneers. In Ontario the first streams to suffer from encroaching settlements were those flowing into Lake Ontario. The Atlantic salmon declined and became extinct from Lake Ontario by the late 19th century. Dams from grist and sawmills on small streams entering Lake Ontario blocked the salmon from reaching the upstream spawning beds. Recovery has occurred in some streams, but experimental plantings of Atlantic salmon fry in Duffin Creek east of Toronto, in the 1950s, revealed that warm water temperatures and lack of overhanging bushes and trees prevented the salmon from surviving. Logging and pulp mills have also had disastrous effects on fish and other aquatic life. The spread of dams for logging, hydro, irrigation, flood control, or recreation, has played havoc with stream flow and aquatic life. Private landowners may damage the ecosystem by cleaning up a stream on their property, straightening it, cleaning out weeds and rocks, and then erecting a dam. Trout streams are among the most sensitive ecosystems. Large scale irrigation, watering cattle, and other farming practices may also damage streams. Highway spills, such as the 1975 overturning of a tanker truck loaded with styrene on Highway 401 near Massie Creek east of Cobourg, may kill all the life in a stream.

063463
WALDICHUK M * **Air-sea exchange of pollutants, Chapter 4** , IN: Pollutant transfer and transport in the sea * KULLENBERG G * v1 177-219 * CRC Press Inc, 2000 Corporate Blvd, NW, Boca Raton, FL 33431, US * 1982.

This review examines the state of knowledge on air/sea transfer processes, with emphasis on chemical and biological aspects, and to identify some of the substances that enter the sea from the atmosphere and vice versa.

062318
WALDICHUK M, BUCHANAN RJ * **Significance of environmental changes due to mine waste disposal into Rupert Inlet** * 56p * 1980-11-15.

This report summarizes the processes involved in the mining and milling operation and methods of waste disposal as they affect the marine environment in Rupert Inlet, British Columbia. Some of the environmental problems arising from this activity are identified and these are ranked according to their ecological impact, especially in their effect on the commercial and recreational fisheries. The operations of Island Copper Mines of Port Hardy, a subsidiary of Utah Mines Ltd., are described. The mining consists of an open-pit operation on the north shore of Rupert Inlet, one of the reaches of Quatsino Sound on the northwest coast of Vancouver Island. A simplified description is given of the extraction processes in the mill. The waste rock from the mine is dumped into the foreshore of Rupert Inlet. The intertidal and shallow subtidal areas of the north shore of Rupert Inlet are being systematically filled in by this waste rock. A description is given of the abundant marine flora and fauna of Rupert Inlet and of the monitoring program conducted by the mining company. General observations are presented on the effects of the mine tailings in the inlet system. The physical dispersion of the tailings and their biological and aesthetic effects are discussed. A comparison is made of the effects of Island Copper mine tailings disposal into Rupert Inlet with other similar sea disposal operations and recommendations are presented classified in terms of the modification of waste disposal systems, monitoring and on research. A list is included of references of subject matter relevant to the problem of mine waste disposal in Rupert Inlet and a list is given of other existing, past, and planned mining operations with sea disposal of wastes.

065795
WALLER DH, HART WC, THIRUMURTHI D * **Halifax Urban Watersheds Program - a case study in urban stormwater quality management** , IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * v2 1001-1017 * Can Soc Civ Eng * (1983).

Release of a previously undeveloped 13.15 sq. km watershed in Halifax, Nova Scotia, following development of an alternative water supply source, provides an opportunity to study water quality impacts of development of

this watershed in comparison with two adjacent watersheds, one developed and one protected from development. Water quality problems are expected to be associated with altered flow regimes, land use changes, highways and railways, acid precipitation, and lake and watershed management. The Halifax Urban Watersheds Program, organized at the Technical University of Nova Scotia in 1981, is undertaking research related to many of these problems, with the objective of contributing to water management capability in these and other watersheds. The work of this program complements other Canadian research related to urban stormwater quality management.

064107
WAN MTK * **Environmental monitoring studies of selected pesticide spray operations in British Columbia** * Reg Program Rep 83-01 * 151p * Environ Serv Branch, Pac Yukon Reg, Environ Prot Serv, Environ Can * 1983-01.

This report summarizes the results of chemical residue and biological measurements in a selected number of operational and experimental pesticide spray applications in British Columbia. The chemical measurement data obtained during herbicide applications were used for the development of buffer zone guidelines to protect salmon and trout fishery habitat areas. Spray drift patterns, air, sediment and water contamination, and persistence of herbicides in the aquatic and terrestrial environments were studied. The impact of certain insecticides on aquatic and terrestrial invertebrates was investigated to evaluate the effects of spray operations on these organisms. Twenty-eight different studies are summarized in seven appendices covering the following pesticide programs: forestry conifer release, rights-of-way vegetation control, forestry insect pest control, mosquito control, agricultural-urban pest control, aquatic pest control and industrial/commercial vegetation and pest control. The body of the report summarizes the results of these investigations, and provides a general assessment of the findings of the monitoring studies.

065985
WATER SURV CAN, INLAND WATER DIR, ENVIRON CAN * **Water quantity/quality monitoring program, Cumberland Marshes Project, 1980 Annual report** (see chapter 4.9 for complete reference - voir chapitre 4.9 pour la reference complete)

064543
WEAGLE K * **An examination of the impact of the discharges from Cyprus Anvil mine on the aquatic environmental quality of Rose Creek, Yukon Territory (1977 and 1978)** * Reg Program Rep: 81-25 * 59p * Environ Prot Serv, Pac Reg, Yukon Branch, Environ Can * 1981.

The impact of the discharges from Cyprus Anvil Mine on the aquatic environment of Rose Creek was studied in 1977 and 1978. It was found that the quality of the environment in Rose Creek had been impacted to a greater extent than had been found in previous years. The major impacts were caused by increases in non-filterable residue, decreases of the dissolved oxygen concentration, and increases in pH in Rose Creek downstream from the mine and mill. High copper and cyanide concentrations in the tailings pond decant discharge resulted in increased toxicity of the discharge to fish.

064418
WEILER RR * **Chemistry of the North American Great Lakes** , IN: International Association of Theoretical and Applied Limnology, Proceedings, UP, 1980 * SLADECEK V * 21(3) 1681-1694 * E Schweiz Verlagsbuchhandlung, D-7000 Stuttgart 1, DE * 1981.

The processes determining the chemistry of the Great Lakes and what the historical changes and the effects of remedial measures have been, are discussed. Concentrations of major inorganic ions, dissolved nutrients (phosphorous, nitrogen and silica), and trace metals and organic substances, are examined. Conclusions drawn include: the basic chemistry of the Great Lakes is determined by mineral - water equilibria with concentrations of chloride and sulphate determined by inputs from the atmosphere and from point and diffuse sources; and, phosphorus is the major plant nutrient controlling phytoplankton growth in the Upper Great Lakes and the nutrient causing accelerated eutrophication in the Lower Great Lakes. The implementation of water pollution control in both the United States and Canada is described, focusing on legislation and regulations and the importance of the 1972 and 1978 Great Lakes Water Quality Agreement to the protection of Great Lakes water quality.

063276
WELSTED J * **The Garrison Diversion Unit - an update** * Can Water Resour J * 8(1) 51-59 * 1983.

The Garrison Diversion Unit (GDU), a massive multi-purpose water resource scheme in North Dakota, has caused controversy between Canada and the United States resulting in a reference to the International Joint Commission (IJC). The IJC concluded that the project as authorized by the United States Congress would adversely affect some Canadian waters particularly with respect to biota transfer from the Missouri System to the Hudson Bay Watershed and therefore recommended against completion of those parts of the project that would affect Canada. However, concern about the project still exists in Manitoba and in North Dakota where, for some time, legal actions stalled the project. Negotiations between Canada and the United States aimed at achieving a final agreement

have started, but little progress has been made. In view of continued opposition from Canadian sources and increasing opposition from within the United States, it seems likely that only a scaled down version of the original project will be completed.

065927
WEST B * **Cattle feedlot manure management: code of practice** (see chapter 8 for complete reference - voir chapitre 8 pour la reference complete)

062849
WESTLAKE GF, SMITH D * **Heavy metal contamination of the Salmon River, Nova Scotia, in the vicinity of Yava Mines lead mine** * Surveillance Rep EPS-5-AR-83-2 * 36p * 1983-01.

Yava Mines Limited operated a 600 ton per day lead mine on the Salmon River on Cape Breton Island, Nova Scotia, from 1979 to late 1981. In July of 1981, in order to evaluate the impact of this activity on the receiving water, sediment and biota were sampled in the vicinityof the mining operation. While the effects on the water column are localized within the first few metres of the mouth of the discharge brook, the sediment is contaminated with heavy metals within the Salmon River itself. Most of this contamination, which reached values as high as 18,078 micro g per g lead, 32.0 micro g per g cadmium, 22.8 micro g per g copper, and 1,011 micro g per g zinc, appeared to be confined to a small cove receiving the discharge. However, sampling was not extensive enough to exclude the possibility of a more widespread dispersal. Some of this contamination may have arisen from land wash through mineralized soils in the area. The relative importance of these two sources could not be established. Biological analyses indicated a stressed environment exists in the cove. Possible corrections include removal of sediments and/or stream diversion around the contamination.

066570
WHITFIELD PH * **Regionalization of water quality in the upper Fraser River basin, British Columbia** * Water Res * 17(9) 1053-1066 * 1983.

Uniformity of water quality in the Upper Fraser River basin was examined using cluster analysis. Substantial variations in water quality exist within the basin. These differences are largely related to the geology of the watersheds. Differences in water quality were more pronounced among the tributaries than along the mainstem of the Fraser River. The mainstem of the river could be considered to have three distinct reaches where water quality properties were relatively constant. Cluster analysis was a useful technique for establishing similarities and differences for both the tributaries and the mainstem stations. Some limitations of water quality data and the methods used are discussed. The diversity of water quality found to exist within this basin suggests that uniform criteria or objectives cannot be applied to the basin as a whole, but may be applied to smaller units.

061825
WHITFIELD PH * **Water quality studies in the Kootenay River Basin I. Nutrient loadings to Kootenay Lake** * 39p * Environ Can, Environ Manage * 1980-06.

A nutrient budget for Kootenay Lake in British Columbia is established for the period from August 1974 to August 1975. Those nutrients studied were total phosphorus, dissolved phosphorus and nitrate plus nitrite. The dominant source of both phosphorus and nitrate plus nitrite to Kootenay Lake is the Kootenay River. Loadings to the lake occur predominantly during the freshet period. The discharge of water from Duncan and Libby Dams during the non-freshet period shifts the loading pattern at the Duncan and Kootenay River stations. During the winter months the nutrient concentrations and daily loadings in the lake discharge increased. The peak inputs of nutrients occured during freshet while the highest outputs from the lake occured during winter. In light of this, the effect of operation of the Duncan and Libby Dams was to spread the nutrient load to periods of the year when nutrient utilization was not as great. Estimates of annual loading to the lake of total phosphorus, dissolved phosphorus, and nitrate plus nitrite are, 789 plus or minus 14, 285 plus or minus 54, and 1963 plus or minus 343 tonnes (kg x 1,000) respectively. Imprecision of the estimates of the loadings provides relatively poor estimates of the amount of material retained in the lake over the study period. Estimates of the retention within the lake are, 156 plus or minus 191 (kg x 1,000) for total phosphorus, and 210 plus or minus 467 (kg x 1,000) for nitrate plus nitrite. Dissolved phosphate transported out of the lake was 94 plus or minus 142 (kg x 1,000) greater than the estimated inputs.

067097
WHITFIELD PH, OLIVER G * **Effects of the Crestbrook Forest Industries Pulpmill at Skookumchuck on water quality of the Kootenay River before and after the implementation of rapid infiltration of the effluent** * 37p * Inland Waters Dir, Pac Yukon Reg, Environ Conserv, Environ Can, Vancouver, BC * 1983-03.

Water quality of the Kootenay River above and below the pulpmill at Skookumchuck was studied from June 1980 to June 1982. The direct discharge of the Skookumchuck pulpmill effluent to the Kootenay River resulted in elevated downstream levels of colour, sodium,

chloride, tannins and lignins and phenolic materials. There was a poorly defined sag in dissolved oxygen downstream of the effluent disposal site. Additionally there were chlorinated phenols present in samples collected downstream of the pulpmill that were not found upstream of the pulpmill. The change in effluent disposal practice in December 1981 from direct discharge to the river to the rapid infiltration system has eliminated the downstream effects of the pulpmill.

065208
WHITING J, CHRISTIANSEN E, HEUSER H, KERMEEN JS, MAATHUIS H, MACHIBRODA P * **Summary report surface water and groundwater investigations of the Lorado Mill area and meteorology data for the Gunnar uranium tailings** * 112p * Sask Res Counc, Sask * 1982-03.

The purpose of this investigation was to establish the quaternary geology and the preliminary hydrogeological and surface water characteristics of the Nero Lake Watershed Basin including the Lorado Mill Tailings Pile. The Lorado facilities have become a major environmental concern due to their proximity and accessibility to the local population. The Lorado tailings have created a very acidic Nero Lake which is leaching into Beaverlodge Lake. The meteorological monitor at the southwest edge of the tailings showed that there is significant variation in the radiation emitted by the tailings during different meteorological conditions. Heavy rain events, appear to have some effect on radiation levels.

062854
WHITTEMORE R * **Issues related to mathematical water quality modelling management** , IN: Prcc of Stormwater and Water Quality Management Modeling Users Group Meeting, 18-19 October, 1982 * WISNER PE * 77-88 * IMPSWM, Univ Ottawa, Dep Civ Eng, Ottawa, Ont K1N 9B4 * 1983-04.

In recent years models have seen continued use in waste load allocation and planning studies. This situation was especially true of the pulp and paper industry which experienced a number of production expansions and even greenfield mill considerations. In reviewing these studies and participating in the planning activities, NCASI had a unique opportunity to make recommendations which have significantly impacted these studies. The major goal in all cases was: (a) to develop water quality models which properly represented the specific deoxygenation characteristics of the paper industry waste, and (b) to integrate these and other data into a credible model which reflects as accurately as possible the observed water quality. It is the intent of this paper to summarize some of these concerns and recommendations communicated during these review activities. These concerns have stimulated research which has been reported in NCASI Technical Bulletins (1-13) and reviewed in part during past SWMM User's Group Meetings. These concerns will be organized as follows: model documentation, parameter estimation procedures, and modeling protocol.

064836
WILSON R (CHAIRMAN) * **Interpretation of 1980/81 surveillance data for the international waters of the Saint John River basin, a report of the International Technical Advisory Subcommittee on water quality in the Saint John River** * 46p * 1982-06.

A fishable (salmonids/aquatic invertebrates)-swimmable goal for the international portion of the Saint John River Basin has been established and water quality objectives developed by the International Technical Advisory Subcommittee (ITAS). Implementation of a recommended monitoring program necessitates comparison of the resulting data with the objectives. Monitoring data from water year 1979/80 suggested that eutrophication may have been occurring in the international portion of the Saint John River as evidenced by high phosphate and low oxygen levels. The major problem identified for heavy metals was with the actual data: too few samples and inadequate detection limits made proper assessment of water quality impossible. These problems were addressed in water year 1980/81, in addition to the needs of the regular surveillance program. This report summarizes the results of several monitoring programs undertaken in Canada and the United States, and identifies potential water quality problems in terms of non-compliance with the established "safe", "acute" and "swimmer's" objectives.

062853
WISNER PE (ED) * **Proceedings of Stormwater and Water Quality Management Modelling Users Group Meeting, 18-19 October, 1982** (see chapter 4.3 for complete reference - voir chapitre 4.3 pour la reference complete)

066161
WOLFE BR * **The role of the lake winter cover in the phosphorus budget of a southern Ontario lake** , IN: Proc Thirty-seventh Annual Eastern Snow Conf, June 5-6, 1980, Peterborough, Ont * GOODISON BE * 170-178 * (1980).

A winter and spring hydrologic and phosphorus budget was calculated for a small lake (10.3 hectares) in the Oak Ridges Moraine Complex, 32 km north of Toronto, Ontario, Canada. Of principal interest were contributions to the spring phosphorus load by aeolian source loading to the winter cover at the lake and terrestrial basin. Six percent of .578 kg of the total winter season

phosphorus load was contributed by the winter snow and ice cover of the lake. Of this, fifty-seven percent was estimated to be derived from aeolian source loading. Total aeolian source loading to the lake from all sources was 22.3 percent.

063260
WONG WM, ZUKOVS G * **Evaluation of inflow/infiltration controls for Stratford, Ontario** , IN: Proc of Stormwater and Water Quality Management Modelling Users Group Meeting, 18-19 October, 1982 * WISNER PE * 249-274 * IMPSWM, Univ Ottawa, Dep Civ Eng, Ottawa, Ont K1A 9B4 * 1983-04.

This study began in 1980 as a part of a broadly based river basin management project (Stratford-Avon River Environmental Management Project), with a view of resolving the water quality problems resulting from treatment plant overflows caused by excessive inflow and infiltration in the tributary sewer system. The study progressed in two phases. In the first phase, catchment data were collected and the sanitary sewer system was monitored to determine the inflow/infiltration rates in each subcatchment within the City. The STORM model was set up and calibrated for simulation of treatment plant overflows. In the model applications, methods were developed for estimating the unknown sizes of the inflow catchments, and for splitting the simulated overflow volume into its two components: raw sewage and primary effluent overflows, so that the pollutant loading of each component could be estimated. In the second phase, the relative effectiveness of storage, additional primary treatment coupled to the existing secondary treatment and source controls on reducing treatment plant overflow were studied with the model. The results of the preliminary simulations provided directions for the remaining work in which the model would be used to assess the effectiveness of various combinations of storage/primary treatment/source control on overflow. The least-cost combination of controls that would meet desired water quality criteria would be recommended to management for adoption.

064316
WURTSBAUGH WA, HORNE AJ * **Iron in eutrophic Clear Lake, California: its importance for algal nitrogen fixation and growth** * Can J Fish Aquat Sci * 40(9) 1419-1429 * 1983-09.

Clear Lake, California, is warm, shallow, polymictic, and eutrophic. During 1975, levels of dissolved (less than 0.45 micro m) iron in all three basins of Clear Lake were always low (15-30 micro g per L) and decreased to 2 micro g per L during the major bloom of Aphanizomenon flos-aquae. Nitrogen fixation (acetylene reduction) rates of the blue-green algal populations were stimulated as much as 500% above control levels by iron additions in laboratory and in situ large-volume bioassays. Carbon fixation rates and chlorophyll a levels were also significantly stimulated by iron additions, but usually less rapidly and to a lesser extent than N2 fixation. Additions of nitrate stimulated carbon fixation and chlorophyll production but inhibited increases in nitrogen fixation. Phosphate additions either had no effect or produced a mixture of stimulation or depression of all three variables. The bioassays indicate that the growth of blue-green algae and other algae in Clear Lake is usually directly limited by combined nitrogen and occasionally by iron or phosphorus. Low iron levels aggravate the effects of low nitrogen by limiting nitrogen fixation, thus reducing blue-green algal growth.

061451
YAU H, MURPHY KL, TIMPANY PL * **Athabasca River modelling studies (Phase 1) Fort McMurray - Embarras** * AOSERP Rep L-76 * 101p * Alta Environ, 15th floor, Oxbridge Place, 9820 - 106 St, Edmonton, Alta T5K 2J6 * 1982-02.

The present and proposed industrial development associated with the Athabasca Oil Sands has resulted in a need to evaluate the Athabasca River transport and assimilation of contaminants and water occurring substances. Since the beginning of AOSERP in April 1975, water quality and quantity data have been collected to provide a general baseline of information. Preliminary studies of the Athabasca River Basin indicate that a mass balance approach may be used to model the chemistry of the Athabasca River. The base model developed provides a reasonable analysis of dissolved sodium, dissolved chloride, total alkalinity, and total hardness between Fort McMurray and the Embarras Airport. It appears possible now to investigate transformations, impacts, and assimilation of non-conservative substances in the Athabasca River utilizing the mass balance concept developed for conservative substances in the study. Once the composite model is calibrated and tested, it would predict mass loading or concentration of a parameter at any point along the study area for different future development scenerios. The resulting evaluations of these development scenerios will allow comprehensive management planning to be completed for the Athabasca watershed.

066131
YOUNG TC, DEPINTO JV * **Algal-availability of particulate phosphorus from diffuse and point sources in the lower Great Lakes basin** , IN: Sediment/Freshwater Interaction, Proc 2nd Int Symp, Kingston, Ont, 15-18 June 1981 * Hydrobiologia * v91/92 111-119 * 1982-07-16.

Control of phytoplankton production in the Great Lakes can be achieved most efficiently by limiting inputs of biologically available P. We report the results of studies performed to characterize the chemical forms and

availability of particulate P in wastewater and tributaries which enter the lower Lakes, the eroding bluffs which border Lake Erie, and bottom samples from the near-shore of western Lake Erie. Rates of release of available P were estimated from a simple first-order model of the process, as observed during algal bioassays. Available P in wastewater samples, as a fraction of total particulate P, was affected minimally by wastewater treatment, including chemical precipitation and filtration; it correlated well with levels of total particulate P. Available particulate P levels in fluvial suspended sediments showed regional uniformity, but appeared to be strongly dependent on levels of both NaOH-P and CDB-P. Rates of release of available P decreased during wastewater treatment to values which were similar in magnitude to those observed for fluvial sediments. Release rates, however, were not related to any of the particulate P fractions which were measured. Analysis of the bluff and bottom samples indicated that P availability in the former was negligible, but the latter contained levels which approached those of wastewater particulates, though available P was released from the bottom sediments at relatively low rates.

061904
YOUNG TC, DEPINTO JV, FLINTE SE, SWITZENBAUM MS, EDZWALD JK * **Algal availability of phosphorus in municipal wastewater** * J Water Pollut Control Fed * 54(11) 1505-1516 * 1982-11.

This paper reports on a study undertaken to determine the biological availability of particulate and soluble phosphorus before, during, and after treatment at several operating municipal wastewater treatment plants in the lower Great Lakes basins and to examine the effect of different treatment processes, including chemical precipitation of phosphorus and filtration, on the availability of municipal wastewater phosphorus. Four municipal treatment plants in the vicinity of the Great Lakes were sampled during the summer of 1979. Available phosphorus in the wastewater samples was determined directly by measurement of the phosphorus taken up by Scenedesmus sp. during bioassays in which the wastewater provided the only source of phosphorus growth. Comparative data on bioassay results and the results of chemical determinations of phosphorus are presented. The directly measured values of available phosphorus, based on the 14-day bioassays are compared with the results of chemical analysis of phosphorus and the estimates of ultimate available phosphorus are compared to the chemical measures. The results showed an average of 55 and 82% of the total particulate and soluble phosphorus was available during short term incubation. The total short-term available phosphorus averaged 72% of the total wastewater phosphorus. The methods used to treat wastewater at the four plants sampled during the investigation had little effect on the relative portion of available phosphorus in the soluble and particulate fractions. Of major importance for the management of phosphorus loads to the lower Great Lakes and other aquatic systems from municipal wastewater treatment plants, is the finding that soluble wastewater phosphorus shows a greater availability than particulate forms. Therefore it was concluded that phosphorus removal methods that minimize the soluble fraction of total phosphorus in municipal effluents and allow achievement of discharge permit standards should yield the greatest benefits in terms of reduced loading of available phosphorus.

063293
ZEAMAN LJ, SLAYMAKER HO * **Estimates of nutrient load carried by the Okanagan River into Osoyoos Lake, Part I** * 98p * Environ Can, Environ Conserv, Inland Waters Dir, Pac Yukon Reg, Vancouver, BC * 1982-06.

Phosphorus removal from the Penticton waste treatment plant and reduction of its loads to receiving waters was undertaken in 1971. During the period from 1976 to 1980, a nutrient loading study was conducted by Water Quality Branch in the southern Okanagan Basin in order to assess the effectiveness of this remedial action. Two major river reaches and the surrounding areas were selected for the study, the Penticton reach of the Okanagan River above Skaha Lake which is directly affected by the changes of nutrient discharge from the Penticton treatment plant, and the reach through Oliver leading to Osoyoos Lake, where similar changes are planned. Four channel cross-sections in the Okanagan River were selected for determination of nutrient loads: below Okanagan Lake, above and below Skaha Lake, and above Osoyoos Lake. Sequential and simultaneous sampling methods were used for collection of water samples in weekly and monthly intervals, respectively. Loads of total phosphorus, total dissolved phosphorus, nitrate plus nitrite, ammonia, organic nitrogen, total nitrogen, and silica were determined by employing a flow interval method, based on sequential sampling, and by a partial load method, based on simultaneous sampling.

063292
ZEAMAN LJ, SLAYMAKER HO * **Estimates of nutrient load carried by the Okanagan River into Osoyoos Lake, Part II, Statistical characteristics of nutrient concentration and load, Okanagan River near Oliver, data report** * 507p * Environ Can, Environ Conserv, Inland Waters Dir, Pac Yukon Reg, Vancouver, BC * 1982-06.

This report was prepared for the Implementation Board under the terms of the Canada-British Columbia Okanagan Basin

Implementation Agreement. It is a computer print-out of statistical data on nutrient concentration and load, at water quality and stream gauging stations in the Okanagan River near Oliver, B.C., from 1976 to 1980. Tables and graphs are given of discharge, total phosphorus, total dissolved phosphorus, nitrate plus nitrite, ammonia, organic nitrogen, total nitrogen, and dissolved silica, and their ratios to each other.

063301
ZEMAN LJ * **Canada - British Columbia Okanagan Basin Implementation Agreement, Statistical characteristics of nutrient concentration and load, Okanagan River below Okanagan Lake, Data report** * 580p * Environ Can, Inland Waters Dir, Pac Yukon Reg, Vancouver, BC * 1982-09.

This report presents statistics on the nutrient concentration and load of the Okanagan River below the Okanagan Lake derived from samples taken between February 1980 and December 1980. A topographic map of the Okanagan River is included and water quality sampling sites are shown. Annual hydrographs of hourly discharges and graphs of discharge ranges derived from historical records are presented. Statistical characteristics of concentrations of the following nutrients are given: total phosphorus, total dissolved phosphorus, nitrate plus nitrite, ammonia, organic nitrogen, total nitrogen, and dissolved silica. Statistics are also given on the ratios of: total dissolved phosphorus to total phosphorus, nitrate plus nitrite to total nitrogen, nitrate plus nitrite to dissolved silica, ammonia to nitrate plus nitrite, ammonia to total nitrogen, organic nitrogen to total nitrogen, total nitrogen to total phosphorus, total nitrogen to dissolved silica, dissolved silica to total phosphorus and total dissolved silica to total dissolved phosphorus. For each nutrient, arithmetic mean concentrations and their statistical characteristics are presented for individual months, all months, and individual years, with graphs of monthly concentration ranges.

063294
ZEMAN LJ * **Statistical characteristics of nutrient concentration and load, Okanagan River below Okanagan Lake, data report** * 580p * Environ Can, Environ Conserv, Inland Waters Dir, Pac Yukon Reg, Vancouver, BC * 1982-09.

This report was prepared for the Implementation Board under the terms of the Canada-British Columbia Okanagan Basin Implementation Agreement. The information is preliminary and subject to revision. The report consists of computer print-outs of statistical data on nutrient concentration and load, at water quality and stream gauging stations in the Okanagan River between Lakes Okanagan and Osoyoos, in 1976-1980. Tables and graphs are given of discharge, as well as of total phosphorus, total dissolved phosphorus, nitrate plus nitrite, ammonia, organic nitrogen, total nitrogen, and dissolved silica, and their ratios to each other.

061821
ZEMAN LJ, ERLEBACH WE * **Mixing of chemical substances in rivers with reference to Okanagan River at Penticton** * 9p * 1981-09.

Dispersion of a plume of dissolved, non-conservative chemical substances from point sources in natural stream water is described as two processes: 1) the convective process in which the movement of substances is dependent on their initial convective velocities in longitudinal, vertical and lateral directions; and 2) the diffusive processes in which spreading of chemical substances is defined by the mean flow velocity and the dispersion of coefficients. A short-term study on the reach of the Okanagan River at Penticton, British Columbia, to examine lateral, vertical and longitudinal variation of nutrient concentration and to determine precision of their transport estimation in the channel where water chemistry is affected by pollutant inputs from various sources, is described. Simultaneous sampling for chemical analysis conducted in combination with hydrometric measurements in five selected cross sections, is outlined. Measurement of ammonia concentration and transport showed significant lateral concentration gradients in the cross sections located below major input sources of nutrients. These gradients indicate that a higher river reach is required to achieve complete mixing of ammonia. Also, it is concluded that penta-chlorphenate could undergo a variety of changes along the investigated river channel.

061828
ZEMAN LJ, SLAYMAKER HO * **Determination of nutrient loads into and out of Skaha Lake** * 191p * Environ Can, Environ Conserv * 1981-12.

This report deals with the results obtained during a three year study of nutrient transport into and out of Skaha Lake, carried out under the Canada - British Columbia Ikanagan Basin Implementation Agreement. This study's main objective was to design a method for improving the precision of nutrient load estimation in order to provide water management with a reliable measure of nutrient flux to Skaha Lake. Concentrations of total phosphorus, dissolved phosphorus, nitrate plus nitrite, ammonia, total nitrogen and dissolved silica were measured below Okanagan Lake and below Skaha Lake using two sampling methods - simultaneous and sequential. Data derived from these two methods were used to calculate nutrient loads by employing the partial load method with simultaneous sampling data and the flow interval method with sequential sampling

data. The simultaneous sampling method revealed very pronounced short range spatial heterogeneities of point concentration measurements of nutrients at all three channel cross-sections. Seasonal changes of concentration measurements, obtained by the sequential sampling method, indicate that below Okanagan and Skaha Lakes, concentrations of total phosphorus are significantly higher during the fall - winter period than during the spring - summer period. A statistically significant correlation was found between the load data obtained by the partial load method and by the flow interval method. The overall mean load of phosphorus determined on lumped data from these two methods during the sampling period indicates a reduced input of total phosphorus to Skaha Lake. Loads of total phosphorus and total dissolved phosphorus increased markedly in the downstream direction at each of the three investigated channel cross-sections. Increases in loads of ammonia, nitrate plus nitrite, and total nitrogen were observed. Loads of silica showed seasonal variation above the inlet and below the outlet from Skaha Lake.

064668
ZIMMERMAN AP, NOBLE KM, GATES MA, PALOHEIMO JE * **Physicochemical typologies of south-central Ontario lakes** * Can J Fish Aquat Sci * 40(10) 1788-1803 * ISSN 0706-652X * 1983-10.

We present basic physicochemical data and principal component analyses (PCA) of both morphometric and chemical variables for 37 Ontario lakes. Multivariately derived composite variables were substituted for more conventional independent variables in several regression models. These composite variables always explained a greater percentage of variance than the standard morphometric variables. A typology derived in part from the PCA was useful in identifying groups of lakes for which the Ragotzkie model predicting maximum depth of the summer thermocline was appropriate and other groups of lakes that appear to be outliers on the basis of insufficient volume. In addition, variables important in defining the typology, particularly z bar : z sub max ratio and lake volume, were shown to be among the most important in a stepwise, multiple linear regression explaining 91% of the variance in nannoplankton to filter-feeding zooplankton ratios in the lakes. This represents a 47% improvement over previously reported results.

4.16.2 Environmental Management and Pollution = Amenagement du milieu et pollution

061833
Environmental Contaminants Act * Water Pollut Contr * 120(6) 9-10,16 * 1982-11.

This fourth review of the list of Priority Chemicals, which appeared in the Canada Gazette January 1982, includes those substances for which regulations are being developed under the Environmental Contaminants Act or concerning those which further study and information are required to determine whether regulation or other action is necessary. The List is an indication of the chemicals that are of particular interest to the Departments of the Environment and of National Health and Welfare for the gathering and analysis of information. The Act is used to regulate the importation, manufacture and processing of any chemical substance that could enter the environment and pose a threat to human health or the environment. Three criteria were applied to the selection of chemicals for the List: toxic effects, persistence, and quantity and use. A discussion of the Schedule to the Act which consists of those substances or classes of substances which the Government is satisfied are entering or will enter the environment in quantities or concentrations or under conditions that constitute a significant danger to human health or the environment, is included.

063679
Prosecution and procedures manual * 48p * Environ Prot Serv, Atl Reg, Environ Can * 1983-01.

The recommendations in this document pertaining to the investigation and prosecution of a pollution incident result from a review of the Canadian environmental case law and, in particular, that applicable to federal environmental legislation. Many of the areas dealt with have not been clearly decided by the courts. A good example would be the use of bioassay results as evidence that a substance is deleterious. When such a situation exists, the author has recommended a procedure which would avoid most of the difficulties previously encountered in court. The various Acts administered by EPS are not described in detail, but rather the main provisions and authority provided by each have been pointed out together with suggested procedures to meet the evidentiary requirements. The suggested procedures for dealing with a pollution incident are based on an environmental emergency situation. Obviously, such an approach would not be required when dealing with a violation of a Fisheries Act Regulation and the procedures should be amended accordingly. The procedures summary contained in Chapter V is intended to serve as a general checklist. It is intended that this checklist be used in conjunction with the detailed discussion on procedures upon which it is based so that the investigator can realize why he is carrying out a particular task. The case law summary is the basis of this document. Obviously, as the case law develops and new environmental legislation is enacted, the document should be

revised to account for these changes. Appendix I contains an initial twenty-six case summaries, which were prepared to illustrate how particular legal issues have been dealt with in past prosecutions.

063566
Proceedings of the Roundtable on the Surveillance and Monitoring Requirements for Assessing Human Health Hazards posed by Contaminants in the Great Lakes Basin Ecosystem, March 17-18, 1982, East Lansing, MI, US * 72p * Int Jt Comm, Great Lakes Reg Off, 100 Ouellette Ave, Windsor, Ont N9A 6T3 * 1982-11.

Proceedings of this conference focused on human health effects of Great Lakes water quality with respect to surveillance and monitoring for organic and inorganic contaminants in fish and water and for microbiological contamination of water. The primary basis for disucssion was the Great Lakes International Surveillance Program of 1978. The merits and limitations of this and other existing surveillance and monitoring programs on the Great Lakes are discussed in the context of the basic objectives of the Roundtable and suggestions made as to how to upgrade the overall process of data collection and information transfer. Recommendations are made in regard to the perceived requirements for surveillance programs as a step towards the development of an overall strategy for the management of toxic substance in the Great Lakes Basin.

066687
Water Quality Branch publications 1981 * 20p * Inland Waters Dir, Water Qual Branch, Environ, Can, Ottawa, Ont * 1983.

This bibliography lists documents published by the Water Quality Branch during 1981. The title of the document and an abstract are given, as well as the availability of the document and where copies may be obtained.

061824
BELLIVEAU PE, BAILEY HS * **Water Quality Branch activities in Nova Scotia 1965 - 1980** * IWD-AR-WQB-81-16 * 78p * Environ Can, Environ Conserv Serv, Inland Waters Dir * 1981-09.

This report gives a brief chronological overview of Water Quality Branch activities in the Province of Nova Scotia. It was not designed to be exhaustive or all-inclusive but only meant to present highlights of the work accomplished over the past few decades. This document summarizes the background of the Water Quality Branch programs, projects and studies, explaining when and why these initiated, how these were conducted and what type of data were generated. Furthermore, it elucidates how the Water Quality Branch evolved over the years in response to new policies and changing institutional needs. It was written with the expectation that reflection on past activities would germinate the seeds for future useful joint Federal/Provincial scientific endeavors.

065703
BETHELL G, DAVIDGE D * **Compliance evaluation of Cyprus Anvil Mine, Faro, Yukon Territory** * Reg Program Rep 81-15 * 33p * Environ Can, Environ Prot Serv * 1981-03.

During the period from August 26th through to the 28th, 1980, the Environmental Protection Service carried out a monitoring study of the effluent discharge from Cyprus Anvil Mine. The purpose of this study was to determine the state of compliance of the mine effluent discharge with the requirements of the Federal Metal Mining Liquid Effluent Guidelines. The activities involved in this study include the following: 1) Collecting composite samples of the effluent discharge over a period of three consecutive days, 2) Collecting grab samples at three locations, two downstream of the tailings pond decant and one upstream of the mine site on Rose Creek, 3) Analyzing the collected samples for a number of chemical and metal parameters, 4) Carrying out in situ bioassay analyses at all sampling locations, 5) Carrying out laboratory bioassay analyses on composite samples collected at the tailings pond decant, and 6) Collecting other information as necessary to assist in evaluating the state of compliance of this mine.

062617
BOWEN WG * **Co-operation is the key to resolution of boundary waters problems** . IN: Environmental Government Affairs Seminar, Proc, Environmental Concerns of the 80's, October, Ont * 263-271 * Air Pollut Control Assoc and Fed Assoc Can Environ * (1982).

This paper discusses transboundary water pollution in relation to the province of Manitoba. Its rivers and streams are subject to the impact of all domestic sources of pollutants and in addition, being at the bottom end of all the major watersheds in the region, they carry pollutants picked up in higher reaches of these watersheds outside of Manitoba. Several mechanisms for dealing with transboundary water issues are discussed including the Prairie Provinces Water Board, Lake of the Woods Control Board, and the International Rainy Lake Control Board. Recently the quality of the waters that cross the Ontario - Manitoba boundary has become a matter of major importance and both provinces have agreed to bi-annual meetings of environmental officials. Manitoba is also on the receiving end of three river drainages from the United States and water development projects in Minnesota and North Dakota are expected to have a direct impact on water flow and water quality in Manitoba. The Garrison Project in North Dakota in particular has

generated concern and publicity. The International Joint Commission, pursuant to the Boundary Waters Treaty of 1901, acts to deal impartially with problems of mutual concern along the U.S. - Canada border. While the Commission's responsibility is to investigate problems and to make recommendations for their solution, implementation of recommendations is at the discretion of the two governments.

066684
CAMPBELL C, KOSTLER J, NG YM * **Industrial effluent monitoring Annual report 1980** * vp * Alta Environ, Pollut Control Div, Water Qual Control Branch * 1981-08.

This report presents the compliance status of industries in the Province of Alberta with respect to the various industrial effluent standards and guidelines. These standards and guidelines were laid down by the Standards and Approvals Division of the Department of the Environment. Included in this report is information, submitted by the industries as monthly reports, compiled by the Water Quality Control Branch, Pollution Control Division, as well as a summary of the Department's efforts in monitoring and surveillance activities in 1980.

063190
CASTRILLI JF (ED) * **Roundtable discussions on toxic chemicals law and policy in Canada, Proceedings of a Seminar held on June 15-16, 1981** * vp * 1981.

The background paper for the seminar entitled "Toxic chemical control in Canada: an analysis of law and policy", by J.F. Castrilli is included in the appendices to the document. It is a summary review of key federal and provincial laws and policies that briefly examines the nature and magnitude of the threat posed by toxic chemicals to human health and the environment, outlines existing legislation and policy and their adequacy, describes international developments in the area and their implications for Canada, and finally, investigates possible improvements in toxic chemical control strategies. The first topic discussed at the seminar was "An overview of the scientific and regulatory adequacy of the Environmental Contaminants Act in relation to control of existing and new toxic substances: where do the burdens of proof lie; how do the risks get weighed; is there an ecotoxicity control gap". The full prepared text of the lead-off statement for the topic discussion by Dr. Ross Hall is contained in the appendices to the report as are the texts of the lead-off statements delivered for each of the other five topics. Topic Two was a discussion of the Board of Review Process under the Environmental Contaminants Act: how effective it is as a system for public hearings on toxic chemical control regulations, with the lead-off statement by Maxwell Cohen. Topic Three was "Toxic chemical information: problems of data gathering, sharing and public access under federal and provincial law; the position of industry on the legitimate objectives of and limits to, claims of confidentiality". The lead-off statement was presented by W.A. Neff. Topic Four was "Jurisdictional issues: the relationship of Environmental Contaminants Act restrictions to provincial laws on toxic substance discharges, storage and disposal". Lead-off statements were delivered by J.N. Mulvaney and G.G. Tegart. Topic Five was "When the administrative and enforcement process goes wrong: what role for parliament, the legislatures, the public and the courts?". The Honorable J.A. Fraser presented the lead-off statement. Topic Six was entitled "Should existing and/or new toxic chemicals be registered before being permitted to be used or continued to be used? What are the public policy advantages and disadvantages of such an approach? Has registration worked in other areas such as pesticides? Could other mechanisms be more effective such as pre-market or pre-manufacture notice?". The lead-off statement was delivered by J.E. Brydon.

062019
CHAPRA SC, WICKE HD, HEIDTKE TM * **Effectiveness of treatment to meet phosphorus objectives in the Great Lakes** * J Wat Poll Control Fed * 55(1) 81-91 * 1983-01.

The initial attempt to reverse the eutrophication of the Great Lakes required that the phosphorus concentration of major point-source effluents be limited to 1 mg/1. The assumption was that this strategy would be less costly than diffuse source controls and that it would hopefully result in compliance with water quality objectives. In addition, uniform treatment of point sources were considered to be politically and legally advantageous because it seemed equitable. However, several later analyses sup 2-5 predicted that phosphorus reductions to below the 1-mg/1 limit would be needed to meet water quality objectives.

062612
CORNWALL GM * **Water a Manageable Resource of the 80's** , IN: Environmental Government Affairs Seminar, Proc, Environmental Concerns of the 80's, October 12-15, 1982, Ottawa, Ont * 500-504 * Air Pollut Control Assoc and Fed Assoc Can Environ * 1982-10-15.

This paper outlines some of the activities of the federal Environmental Protection Service (EPS) with respect to water pollution control. Together with other levels of government it has succeeded in facilitating improvements in the Great Lakes. Other achievements include the reduction of pollution discharges from the pulp and paper industry, reduction of mercury discharges from chlor-alkali plants and reductions in the

effluent discharges from petroleum refineries. EPS was involved in the development of operator training programs and manuals for use by wastewater plant operators, and along with industry helped to develop a pollution control technology in the seventies. Initially the programs of EPS were orientated towards pollution control at source. Now there is a movement towards the ecosystem concept which recognizes that government involvement in issues should be pursued in relation to the whole system. Environment Canada's most effective role is as a repository of technical and scientific information.

064716
CORNWALL GM * **Federal policies for toxic contaminants control, Chapter 1** . IN: Waste Treatment and Utilization, Theory and Practice of Waste Management 2, Proc Second Int Symp Univ Waterloo, Waterloo, Ont, June 18-20, 1980 * MOO-YOUNG M, ROBINSON CW, FARQUHAR GH * 3-9 * Pergamon Press, Toronto, Ont * 1982.

Environmental protection issues are changing as we enter a new decade. As a result of increased public awareness of the adverse effects of toxic contaminants such as PCBs, chlorofluoromethanes, mercury, and others, environmental health -- including fear of involuntary exposure to invisible toxicants -- is a growing concern among many Canadians. These problems of a global nature require national and international cooperation. Environment Canada is developing a new federal environmental protection policy which, among other things, will put forward the need for new federal legislation to protect the environment and human health against toxic chemicals and their hazards. The policy and accompanying legislation will look at the environment as a whole rather than as a collection of disparate parts. Environment Canada is establishing a Toxic Chemicals Management Program to coordinate government activities, and make the delivery of government services more efficient.

065735
DICKSON B * **Niagara clean-up needs money and 'political will'** * Civic * 35(12) 26-28 * Maclean Hunter Ltd, Maclean Hunter Build, 777 Bay St, Toronto M5W 1A7 * 1983-12.

The Niagara River is a continuous source of trace metals and organic substances in Lake Ontario, Murray Brooksbank told a seminar in Toronto, sponsored by the Pollution Control Association of Ontario and the Ontario Ministry of the Environment. Brooksbank is Niagara River Co-ordinator for Environment Canada. The seminar was billed as: 'Toxic contaminants in the Great Lakes - the International Challenge'. Some 300 toxic substances have been identified in the river. Monitoring, surveillance and research programs undertaken by Canada under the Water Quality Agreement have defined the nature and extent of pollution problems in the Niagara River. Commercial fishing bans on Lake Ontario and consumption restrictions on some sport fish because of PCBs and mirex are attributed to the Niagara River as the predominant or single-source input. Brooksbank laid most of the blame for contaminant problems of the Niagara River as the predominant or single-source input. Brooksbank laid most of the blame for contaminant problems of the Niagara River at the door of US industrial manufacturing plants. New York State has identified 215 chemical waste dumps in the Niagara/Erie county area, 164 of which are located within 3 miles of the Niagara River. The US formulated the Niagara Frontier Agenda, an action plan to co-ordinate the activities of EPA and the NY State Department of Environmental Conservation in an acceleration of pollution abatement efforts. For its part, the Canadian government looks upon Niagara River pollution as a bilateral issue where control activities should receive priorities "that may extend beyond those normally accorded by US domestic programs". Consultation with the US has been sought so that Canada may have the opportunity to review and comment on remedial measures. The cleaning up of the river will be extremely costly and will take considerable ingenuity, time and effort.

066492
DUNCAN L, SMART W, FLETT J * **Legal aspects of aquatic toxicity, Rv. Great Canadian Oil Sands: a case study** . IN: Proc 9th Annu Aquatic Toxicity Workshop, 1-5 Nov 1982, Edmonton, Alta * MACKAY WC * Can Tech Rep Fish Aquat Sci 1163 * 217-219 * Fish Oceans Can, Fish Habitat Manage Branch, Ottawa, Ont K1A 0E6 * 1983-11.

The Great Canadian Oil Sands (GCOS) (Rv. Great Canadian Oil Sands). District Court of Alberta, January 10, 1978 case has left Alberta lawyers and scientists confused as to the required evidence for proof of charges in the province under the Fisheries Act. In 1976 Great Canadian Oil Sands was prosecuted for violations under the Fisheries Act. It was alleged that GCOS had discharged 400,000 gallons per day of a substance containing cadmium and vanadium from pipes in the dykes of the tailings pond. Water samples were taken and bioassay tests performed with brook stickleback and rainbow trout. The judge held there was no evidence of dead fish along the river and that actual damage to fish was necessary before there was an offence under the Act. GCOS was acquitted. This ruling was appealed, but the appellate judge found the company not guilty. This decision is inconsistent with decisions from similar prosecutions in British Columbia. Many unanswered questions have been raised. Only further prosecutions will result in clarification of these issues, so that government and industry will know how the law

is to be interpreted in Alberta.

065924
ENVIRON CAN, INLAND WATERS DIR, WATER QUAL BRANCH * **Water Quality Branch Publications 1982** * 31p * Environ Can, Inland Waters Dir, Ottawa, Ont * 1983.

This bibliography lists documents published by the Water Quality Branch during 1982. The title of the document and an abstract are given, as well as the availability of the document and where copies may be obtained.

062776
GALLOP RA, HYDAMAKA A * **Efficient "point-source control" versus inefficient "end-of-pipe" approaches to the use and resue of water** . IN: Water resue in the future. Proc Water Reuse Symp II, 23-28 Aug 1981, Washington, DC, Vol 3 * 1820-1859 * Am Water Works Assoc (AWWA) Res Found, 6666 West Quincy Ave, Denver, CO 80235 US * (1981).

This paper highlights the popular, expensive, pollutional fallacies about water and its management; stresses the scientific principles required for success in water management matters; shows how these can be applied in designs which must be very efficient, effective and desirable; illustrate what Nature now requires, if there is to be enough clean water much longer; induce more water professionals to teach, design, build and operate systems which emphasize quality with efficiency; induces buyers of water services to require a higher standard of performance from professionals and operators of water systems, by productivity payments for innovativeness; and alerts taxpayers, public officials, educators, students, environmental leaders and other, as to the reasons behind the worldwide, apparently insoluble problems of water management.

066672
GODAVARI SN * **Hazardous and special waste, A bibliography, 1980 - 1983** * 94p * Man Environ * (1983).

This selective bibliography cities material on hazardous waste management from January 1980 to February 1983. The year 1980 is significant as it was the year when the U.S. Environmental Protection Agency (EPA) issued the final regulations for defining and disposing of hazardous wastes under the Resource Conservation and Recovery Act (RCRA) hazardous waste requirements of 1976. In addition, 1980 saw the enactment of the Comprehensive Environmental Compensation and Liability Act (CERCLA). This the literature reflects the impact of the U.S. legislation on American hazardous waste management. We can benefit from their examples. The citations have been compiled from various on-line data bases, catalogues, and a selected survey of relevant periodical indexes. References to literature on specific hazardous wastes and ocean incineration were omitted. The need for revision and updating of the bibliography will be considered as more documentation is published.

063776
GRIMA AP * **The utilization of public input in water quality management: a case study and discussion, Chapter 16** . IN: Water problems and policies * SEWELL WRD, BARKER ML * Cornett Occas Pap No 1 * 173-186 * Dep Geogr, Univ Victoria, Victoria, BC V8W 2Y2 * 1980.

This paper provides a rationale for the evaluation of public inputs and in particular, for evaluating the content of the input made by the eight Canadian Public Consultation Panels to the International Reference Group on Great Lakes Pollution from Land Use Activities (PLUARG) in 1977-78. It also provides background information on PLUARG's public consultation panels and attempts to assess the utilization of the public input via a comparative content analysis of the panels' reports and the PLUARG draft report. On the whole, PLUARG made a genuine effort to include public input into the pollution control policy of a very extensive, complex, and binational water basin. The main lesson from the PLUARG case study is that the public should have been consulted earlier or on an on-going basis.

066361
INT JT COMM, GREAT LAKES SCI ADVIS BOARD * **1983 annual report, report of the Aquatic Ecosystem Objectives Committee** * 74p * Int Jt Comm, Great Lakes Sci Advis Board, Windsor, Ont * 1983-11.

063062
MANITOBA, CLEAN ENVIRON COMM * **Report on a proposal for the classification of Manitoba's surface water, Grass - Burntwood Rivers Principle Watershed Division** * 122 * Man Clean Environ Comm * 1982-06.

This report comments on a proposal containing background information and recommendations for specific water quality objectives for the Grass-Burntwood Rivers Principal Watershed Division, prepared by the Environmental Management Division of Manitoba's Department of Consumer and Corporate Affairs and Environment. A copy of the proposal is included as an appendix. It was prepared following a review of existing and anticipated water uses in the drainages of these two rivers and following study of the scientific literature to develop appropriate objectives for the many individual components of water quality. The proposal contains descriptions of the topography, people, hydrology, climate and resources of the Grass and Burntwood River basins. In the proposal, the "nondegradation" classification is recommended for the unspoiled wilderness and

semi-wilderness areas of the upper portions of both river systems. Public hearings were conducted and evidence received at these hearings is reviewed. The Churchill River Diversion Project is discussed and the conclusions and recommendations of the Clean Environment Commission relative to the Grass-Burntwood Rivers are summarized.

066598
MARUSCHAK D * **Surface water quality management in Alberta: policy and institutional arrangements** * Alberta Environ, Res Manage Div, Uned Mater OF 58 * 168p * 1983-08.

Alberta Environment's South Saskatchewan River Basin Planning Program recognized the need to evaluate present approaches to managing water resources. The objective of this project was to identify present weaknesses and opportunities for change in the policy-institutional framework for water quality management. Recognition was given to the operational constraints that exist in implementing policy and programs. The management of water quality is not completely unified under Alberta Environment. The legislative mandate of a number of agencies is sufficiently broad that jurisdictional problems with Alberta Environment can arise. However, the operational mandates have for the most part been adjusted so that the authority for water quality management is not fragmented. Although ancillary agencies provide support services to Alberta Environment, there are in some cases no formal mechanisms for integrating their concerns into the regulatory process. Alberta Environment has not developed a set of policies which would set priorities among uses and guidelines to be followed by regulatory and economic instruments to maintain beneficial uses. The present approach is regulatory in that it is directed to maintaining secondary treatment standards for municipal wastewater and best practicable technology standards for industrial wastewater. Policy and program vacuums exist for managing intensive livestock operations, agricultural drainage and stormwater.

063525
MCBEAN EA, ZUKOVS G * **A methodology for pollution control decision analysis** * Can Water Resour J * 8(2) 64-87 * Can Water Resour Assoc, PO Box 250, Kingston, Ont K7L 4V8 * 1983.

A two-stage matrix methodology is developed for use in the selection of pollution control strategies. The initial stage is a cursory or screening assessment level used to identify whether additional study is needed. The second stage includes the determination of the various alternatives for pollution control on a set of evaluation criteria. Dominance testing is used to select the best alternative. A case study application for the model is provided.

063775
MCPHEE M * **Public involvement in setting and enforcing pollution control standards in British Columbia, Chapter 15** . IN: Water problems and policies * SEWELL WRD, BARKER ML * Cornett Occas Pap No 1 * 165-170 * Dep Geogr, Univ Victoria, Victoria, BC V8W 2Y2 * 1980.

This paper offers a critical examination of the role of two forms of public involvement in the pollution control decision making process in British Columbia: Public Inquiries and Pollution Control Board Appeals. The administration of pollution control in the province is outlined and a discussion of Public Inquiries reviews the 1970 and 1976 Public Inquiries held to establish and review the Pollution Control Objectives for the Forest Products Industry. It is suggested that public participation has been limited with respect to: (1) the terms of reference under which the inquiries are conducted, and (2) the range of information which has been allowed at the Inquiries. The appeal procedure and the composition of the Pollution Control Board are described. The most common appeal is over the granting of a pollution control permit. The Appeal process is potentially a useful form for interested parties to participate in pollution control decisions. However, the process can only be initiated with the granting of a permit.

066847
MUNICIPAL ABATEMENT TASK FORCE, WATER QUALITY PROGRAMS COMMITTEE, INTERNATIONAL JOINT COMMISSION * **A review of the municipal pollution abatement programs in the Great Lakes Basin** * 184p * Int Jt Comm, Great Lakes Reg Off, 100 Ouellette Ave, Windsor, Ont N9A 6T3 * 1983-11.

This report describes the findings of the Municipal Abatement Task Force regarding municipal wastewater treatment facilities and pollutant inputs in the Great Lakes System. It includes the results of five working groups which: compiled an inventory of all municipal wastewater treatment facilities in the basin; conducted detailed assessments of selected municipal wastewater treatment facilities; examined the jurisdictional pollution control programs and requirements; reviewed programs to control combined sewer overflows; and, assessed monitoring and data quality assurance programs, all based on 1981 data, the last full year that a complete data set was available. It also summarizes progress which has been made in municipal wastewater pollution abatement during the past decade and identifies areas for improvement in the future.

062613
NORMAN JD * **Water quality criteria: used or usable water?** , IN: Environmental Government Affairs Seminar, Proc, Environmental Concerns of the 80's, October 12-15, 1982, Ottawa, Ont * 487-490 * Air Pollut Control Assoc and Fed Assoc Can Environ * 1982-10-15.

This paper comments on several aspects of existing water quality criteria and suggests some approaches for the eighties to improve the present situation. Several examples are given of chemical parameters in water in order to make comparisons between used and usable water. Variations in regulations between provinces are noted as well as variations with regard to water use. The militant enforcement of regulations with respect to control of effluent discharges from industry is noted while at the same time there appears to be a lack of control on water quality produced by a water treatment plant for human consumption. It is recommended that more emphasis be put on criteria for "usable" water and that criteria for "used" water be de-emphasized. If the major concern is for protecting the public, the emphasis of the 80's should be on realistic mandatory requirements for usable water.

063564
PET REFINERY POINT SOURCE TASK FORCE, WATER QUAL PROGRAMS COMM * **A review of the pollution abatement programs relating to the petroleum refinery industry in the Great Lakes Basin** * 138p * Int Jt Comm, Great Lakes Reg Off, 100 Ouellette Ave, Windsor, Ont N9A 6T3 * 1982-11.

This report of the Petroleum Refinery Point Source Task Force of the Water Quality Programs Committee of the Great Lakes Water Quality Board describes the Task Force's findings regarding effluent quality improvement, analytical protocols, trends of pollutant loading, and compliance with jurisdictional effluent limitations by the petroleum refining industry in the Great Lakes Basin. An overview of the historical progress (1972-1982) made by this industry to reduce its discharge of pollutants into the Great Lakes, is provided, focusing on the 15 refineries discharging into the Great Lakes Basin. Pollution abatement programs in Canada, specifically federal and Ontario programs, and programs in the United States, notably federal, Wisconsin, Michigan, Ohio, Indiana, and New York programs, are reviewed. Self-monitoring and inspection programs, discharge trends, compliance, areas of concern, toxic and nonconventional pollutants, oil spill prevention, and solid waste disposal, are described. The Task Force concludes that since 1976 there has been a significant improvement in the quality of the wastewater being discharged from petroleum refineries to the Great Lakes Basin.

063536
SABATINI G, MARCOTTE BM * **Water pollution: A view from ecology** * Mar Pollut Bull * 14(7) 254-256 * 1983-07.

The results of various methods typically used by governments to assess the environmental impact of potential pollutants do not give comparable results. It is argued that the cause is not the assessment techniques themselves but rather the paradigm of ecology from which they spring.

066469
SHINDLER DB * **The role of biology in the Water Quality Branch monitoring program** * 7p * Environ Can, Inland Waters Dir, Water Qual Branch * 1981-04.

The Water Quality Branch provides data and interpretive information on the quality of inland waters of federal interest. Since its inception the Branch has continually adjusted its program and adopted new techniques to effectively produce relevant information as new aquatic environmental problems were identified. Although the mainstay of the Branch's monitoring program involves physical/chemical measurements of water, the Branch has always optimized the utility of the data it generates by sampling the appropriate aquatic media and using the most cost-effective techniques available. To address environmental contamination and degradation problems, the Branch must continue to use, on a selective basis, biological techniques to complement chemical measurements and enhance water quality evaluations. The introduction of biological techniques has raised concerns that 'biological monitoring' is a new program and will require extensive additional resources. The Branch, however, has only one monitoring program and the sampling and analysis of biota is only one of many elements (activities) within that program. Moreover, cost-effective application and efficient utilization of regional facilities and expertise will minimize additional resource requirements. The resource shifts necessary to accommodate the selective application of biological techniques are not expected to increase overall program costs but will be met from intra-program trade-offs (e.g. increased efficiency from streamlined sampling and automated analyses) without compromising the Branch's basic physical/chemical monitoring. A well-managed biological component will allow the Branch to effectively meet the challenges of the 1980's.

064480
SPROULE-JONES MH * **The real world of pollution control** * 128p * Univ British Columbia, Westwater Res Cent, Vancouver, BC * 1980.

A case study that addresses the technical, institutional, and social areas of pollution control and environmental management of the Fraser River basin in British Columbia, is

described as it applies to other river basins, public policies and time frames.

064987
SULLIVAN WH * **An overview of the background and development of the Canadian mercury chlor-alkali air emission regulation** . IN: Proc 73rd Annu Meet Air Pollut Control Assoc, Montreal, Que 22-27 June 1980 * v2 12p * (1980).

This paper reviews the history of the Canadian chlor-alkali industry. There have been 17 mercury cell plants in Canada, of which 5 remain. Most of those that ceased operations did so in 1973 or later. Increasing global awareness of mercury related environmental problems first surfaced in Japan and caused the recognition of a mercury problem in Canada. In 1969 Fimreite sent a report to the Canadian Wildlife Service on mercury pollution, and in 1970 he found fish from Lake St Clair were contaminated with mercury. The Wabigoon - English River system and the Peninsula Harbour area of Lake Superior were found to contain fish with elevated Hg levels, and Dryden Chemicals and American Can of Canada were identified as the sources. All these Ontario chlor-alkali plants subsequently ceased operations. In Quebec the Lac Quevillon area fish were found to have high mercury levels, downstream from the Domtar plant. British Columbia had a problem with mercury at Howe Sound, into which FMC Chemicals discharged mercury-contaminated wastewater. Regulations were issued by the Water Pollution Control Directorate of Environment Canada in 1972 limiting mercury discharges to the water course to 0.005 lb per ton of chlorine produced. Canada based its regulations on the best available technology approach. The lowest emissions which the plants could achieve with the best technology available was 5 g of Hg per day per 1000 kg of rated capacity from the cell room and 0.1 g per day per 1000 kg of rated capacity from each of the hydrogen, end-box and retort streams. A Table summarizes the emissions and control equipment with respect to Canadian industry. The burden on the environment has dropped from 239,000 lbs Hg in 1973, to 21,500 lb in 1979. New plants can incorporate mercury-free type processes.

064640
WATER QUAL BRANCH, STAND APPROVAL DIV, ALTA ENVIRON * **Esso Resources Cold Lake Project tentative effluent standards** * 13p * 1980-01-22.

The discharge of liquid effluent originating from the Esso Resources Cold Lake Project was assessed in terms of water quality impact design considerations on the North Saskatchewan River and Beaver River at the Alberta-Saskatchewan Boundary. Effluent standards were derived on the basis of assuring long-term compliance with proposed ambient water quality requirements and projections of the applicant's effluent quality data. Specifically, impact design considerations consisted of relevance to the Prairie Provinces Water Board interim ambient water quality requirements on the Beaver River and a tentative proposal for discharge to the North Saskatchewan River. The study also included an analysis of the applicant's submsision based on in-plant maximum/minimum recycle capability during the 1 in 10 probability of the 7 day consecutive low flow occurrence in the river. The emission discharges incurred during the minimum recycle-maximum effluent flow discharge will not meet the effluent standards (particularly SO4 and total dissolved solids) that are necessary to assure compliance with the Prairie Provinces Water Board interim requirements for the Beaver River at the 1:10 low flow of 0.77 cubic metres per second even if much less stringent limitations are placed on sulphates, sodium, and total dissolved solids concentrations. However, the emission discharges will generally meet effluent standards to comply with a tentative proposal for revised ambient water quality requirements of the North Saskatchewan River at the Alberta-Saskatchewan Boundary.

066689
WATER QUAL OBJECTIVES STAND GROUP * **Guidelines for surface water quality, Vol. 2 Organic chemical substances, hexachlorobutadiene** * 11p * Inland Waters Dir, Water Qual Branch, Environ Can, Ottawa, Ont * 1983.

A literature survey was carried out on the toxic effects of hexachlorobutadiene on human health, aquatic life, plants and livestock. The information is summarized in this publication. From it, maximum hexachlorobutadiene concentrations in water at which toxic effects will not appear are recommended.

4.16.3 Data Collection - Collecte de donnees

065720
Sampling for water quality * 55p * Water Quality Branch, Inland Waters Dir, Environ Can, Ottawa, Ont * 1983.

This manual was designed to help the water quality investigator in the field. It outlines procedures which are currently practised and recommended by staff of the Water Quality Branch. The sample containers, preservatives and sampling procedures described are those commonly used for physical, chemical and bacteriological analyses.

063676
Canada - Saskatchewan Memorandum of Agreement for Water Quality Surveys, Annual report 1981-82 * 77p * 1982-08.

Canada and Saskatchewan have cooperated in the collection of surface water data beginning with fiscal year 1975/76 under terms set out in a Memorandum of Agreement. The Agreement, along with Schedules A, B, C and D which detail operational, administrative and cost sharing arrangements, is included as Appendix III. This seventh annual report summarizes activities and program cost sharing for the fiscal year ending March 31, 1982. The federal share of 1981/82 program costs was $645 619; the provincial share was $381 085. A provincial credit carryover of $14 653 from 1980/81 and a 1981/82 payment of $349 774 results in a provincial deficit of $16 658 for 1981/82 operations. This deficit was primarily the result of a significant increase in vehicle operating costs as well as a large increase in unit salary costs.

065839
AQUAT BIOL GROUP, ALBERTA ENVIRON CENT * **Research and service program plans: Aquatic Biology Group** * vp * 1980.

In the first section of this report, proposed projects of the Aquatic Biology Group are listed and summarized. The projects in the Effects of Industrial, Agricultural and Municipal Wastewater Programs are: effluent monitoring bioassays; genetic toxicology of wastewater; pathological effects of wastewater; chemistry of wastewater; aquaculture (fish maintenance); and water treatment system. The projects in the Effects of Novel Chemicals on Aquatic Systems Program are: toxic residues in fish tissues; environmental chemistry of novel chemicals; and effects of novel chemicals on animal tissues. The projects in the Aquatic Habitat Program are: ecological field studies; bottom sediment toxicology; and pathological effects as biomonitoring tools. The second section of the report is "Research program planning, Aquatic Biology Group" by James Moore. It recommends areas of research in the aquatic bioassay section, and formation of sections of limnology and aquatic vertebrates. It also discusses support requirements for research. The third section, "Research program planning, Aquatic Bioassay Section" by James Moore and William Lake, discusses the future direction of the Aquatic Bioassay Program. The 4th section, "Research program planning, Aquatic Vertebrate Section and the Limnology Section" by James Moore, discusses formation of sections on Limnology and Aquatic Vertebrates, and project areas for these sections.

062375
BARABAS S * **Progress in the development and implementation of the UNEP program for global water quality monitoring** , IN: Management of industrial wastewater in developing nations * STUCKEY D, HAMZA A * 44-51

Acting on decisions reached at the United Nations Conference on the Human Environment held in Stockholm in June 1972, a worldwide network of water quality monitoring stations is being established on major rivers, lakes and aquifers. The project is known as the Global Environmental Monitoring System for Water, or briefly, GEMS/WATER. The main objectives of the GEMS/WATER project are to: Monitor the incidence and trends of pollutants in water; Warn governments of any serious deterioration; and Prompt governments to initiate individually and/or collectively, corrective action. During the first 3-year phase of this project (1977-1979) appropriate methodologies were developed for the selection of monitoring sites, sampling, analysis, analytical quality control, hydrological observations and data storage and retrieval. Also training courses in GEMS/WATER applications were held in most regions of the world. By the end of 1979 a total of 388 water quality monitoring stations were designed in 62 countries participating in the GEMS/WATER project. During 1980, water quality data from almost all designated monitoring sites were received. Various operational aspects of this major international effort are discussed.

065090
BINGHAM R, HOWELL G * **Report on 1982 Saint John River automatic water quality monitor data at Grand Falls, N.B.** * IWD-AR-WQB-83-47 * 56p * Environ Can, Inland Waters Dir, Water Qual Branch, Atl Reg, Moncton, NB * 1983-09.

This report presents data from the Grand Falls Automatic Water Quality Monitor for the period of August 10, 1982 to October 23, 1982. The parameters monitored include pH, water temperature, oxygen saturation and specific conductance. It was found that these parameters complied with the water quality objectives of the International Technical Advisory Subcommittee on water quality of the Saint John River, on nearly all occasions. The relationship between mean daily discharge and specific conductance at Grand Falls was investigated. A good relationship was found between the logarithmic values only after allowing a 24 hour lag in chemical response to changing discharge. This lag in response can be attributed to the large surface area headpond located at Grand Falls.

064906
CASEY D, NEMETZ PN, UYENO DH * **Sampling frequency for water quality monitoring: measures of effectiveness** * Water Resour Res * 19(5) 1107-1110 * 1983-10.

Selecting the sampling frequency is one of the most important tasks in the design of a regulatory water quality monitoring program. This paper proposes two quantitative measures of the effectiveness of different sampling frequencies; these measures are intended to be used at the preliminary program design stage. The goal of the program is assumed to be the

detection of violations of water quality standards. The first measure gives the expected proportion of violations that will be detected. The second measure is the ratio of the expected number of violated samples over the expected number of violations. Mathematical expressions for both statistics are developed. It is shown that by setting the average sampling interval equal to the average duration of a violation, the expected number of violated samples would equal the expected number of violations, since the errors caused by missing some violations and counting others more than once would tend to cancel out.

063049
CHAU ASY * **Standard reference materials in environmental quality assurance** * Water Qual Bull * 8(1) 26-29,53-54 * Can Cent Inland Waters, WHO Collaborating Cent Surf Ground Water Qual, Burlington, Ont * 1983-01.

Most phases of environmental protection and pollution control depend on the identification and measurement of pollutants in the environment. Quality assurance must be an integral part of environmental analytical and data interpretation activities, because questionable data results in questionable interpretation, and questionable decisions or conclusions. The two classifications of quality assurance, intralaboratory and interlaboratory, are discussed here in some detail. A limitation of intralaboratory quality assurance is that it cannot assess the comparability and compatability of data or methods with other laboratories contributing to the same study or data bank. Research to develop Standard Reference Materials (SRMs) and Reference Materials (RMs) for both organic and inorganic parameters in environmental substrates is required. SRMs are stable, homogeneous and well-characterized reference materials prepared in quantity, having essentially identical or very similar matrix to the test samples in order to eliminate or minimize matrix effect between reference and test samples. RMs are similar but less vigorously treated. The article discusses the development and preparation of SRMs for inorganics and for organics in sediments and water. The recently developed SRM for PCBs in lake sediment is the first matrix SRM of naturally contaminated organics. In the last 2 years, 4 round-robin studies on PCBs turned out worse than expected, as questionable data were generated from experienced and well equipped laboratories. SRMs are essential in any effective quality assurance programs.

063666
FORD JS (ED) * **Prototype designs for surveys and measurement in an aquatic environment, 1981** * 53p * Environ Can, Hydraul Div, Natl Water Res Inst, Can Cent for Inland Waters, Burlington, Ont * 1983.

The designs described in this report are the work of an engineering team which specializes in equipment and instrumentation for obtaining data and samples to do with lakes and rivers. Some of these developments may be of interest and useful to others. For that reason, this compilation has been assembled. The list covers a wide range of projects in electronic and mechanical engineering.

063662
GUILBAULT RA * **Design analysis of SYSTEM/140 Project 0140A31 international automatic water quality monitoring** * 23p * Environ Can, Environ Manage, Inland Waters Dir, West North Reg, Water Qual Branch * 1980-03-24.

The objectives of Project 0140A31 are to maintain continuous operation of the water quality monitors located in the Red and Souris Rivers and to report monthly on the quality on these surface waters. A Schneider Robot RM25 monitor is operated on a continuous basis at Emerson, Manitoba, on the Red River. A Philips 9835 monitor is operated near Coulter, Manitoba and another near Glen Ewen, Saskatchewan on the Souris River. Located at the international boundary, they ensure protection of Canadian interests. Monthly grab samples are collected to allow monitor to laboratory comparisons, and to supplement the monthly reports with complete parametric coverage. Parameters monitored include water temperature, conductance and turbidity; coliform; nutrients; alkalinity; heavy metals; and synthetic organic compounds. Until recently only one automatic water quality monitor was operating on the Red River, and the record was compiled by hand into a monthly report. When two additional monitors were installed on the Souris River, it was felt the data should be recorded on a machine-readable medium. Of the four solutions available to communicate the data, current status only, data playback, continuous contact, and satellite retransmission, the latter is the least costly. An overview and design details of SYSTEM/140 are given.

066697
GUILBAULT RA * **Initial quality control results from a Canadian water quality assessment network** . IN: Third Biennial Plains Aquatic Research Conf, Proc, August 24 and 25, 1983, Montana State Univ, Bozeman, MT * SCOTT MD * Can Plains Proc 11 * 179-190 * Inst Nat Resour, Dep Earth Sci, Montana State Univ and Can Plains Res Cent, Univ Regina * 1983.

The Western and Northern Region Water Quality Branch of Environment Canada contributes to the National Water Quality Assessment Program by routinely sampling a number of streams and lakes located throughout the prairie provinces and the Northwest Territories. In order to control the overall quality of the results contributed to the

Program, the Branch instituted a Field Quality Control Project which consists of collecting a selected number of samples in triplicate. The Project was started in 1977. This report presents the results for nutrient parameters (Carbon, Nitrogen and Phosphorus). The total precision is estimated as the median of the coefficients of variation computed on sets of three observations. For eight of the 12 parameters for which analytical precisions are available, the total precision was less than or equal to the analytical precision. However, when maximum coefficients are combined with total precision in a simple classification scheme, only four parameters can be said to have "good" precision. Possible factors which might influence precision such as concentration, river discharge, and the time interval between sampling and receipt in the laboratory, showed no definite correlation. Examination of the 20 sets with the highest coefficients points to a wide variety of random factors which cause poor precision.

065803
INLAND WATERS DIR, WATER QUAL BRANCH, ENVIRON CAN * **Guidelines for surface water quality, Vol. 1 Inorganic chemical substances, Uranium** * 18p * Environ Can, Inland Waters Dir, Water Qual Branch, Ottawa, Ont * 1983.

A literature survey was carried out on the chemically toxic effects of uranium and uranium compounds on human health, aquatic life, plants and livestock. All the information collected is summarized in this document and, from it, maximum uranium concentrations in water at which toxic effects will not appear are recommended.

066604
SNEDDON DT * **Hydrotechnical research in the Alberta Oil Sands** (see chapter 5.2 for complete reference - voir chapitre 5.2 pour la reference complete)

067016
SPEYER MR * **Summary of water quality criteria workshop sessions** . IN: Proc 9th Annu Aquatic Toxicity Workshop, 1-5 Nov 1982, Edmonton, Alta * MACKAY WC * Can Tech Rep Fish Aquat Sci 1163 * 220-223 * Fish Oceans Can, Fish Habitat Manage Branch, Ottawa, Ont K1A 0E6 * 1983-11.

This paper summarizes the 2 days of discussion sessions of the water quality criteria (objectives) workshop. The specific views and concerns of each panel member (MR Speyer, MC Taylor, GR Craig and RCH Wilson) are briefly described. Development of water quality objectives is an issue of concern. Different agencies will use different approaches to establish objectives, and arrive at different values depending on the desired level of protection. More conflicting endpoints can be expected in the future, and less agreement between agencies, as new objectives are developed. The majority of participants recognized existing objectives as being "better than nothing". They provide a reference point for further discussions between government and industry in setting final site-specific receiving water objectives. One panel member suggested that industry become more involved in the review process and actually participate in the development of objectives and regulations. This would result in industry and government becoming collaborative partners in environmental protection.

061832
WATER QUAL BRANCH, INLAND WATERS DIR, WEST NORTH REG * **Index of water quality data, Alberta** * WQB-81-1 * 45p * Environ Can, Environ Conserv Serv * 1981-04.

This index outlines the locations in Alberta at which water quality data have been collected, analysed, and stored by or under the supervision of the Water Quality Branch. The data at each of these stations are stored in the computerized data bank of the Water Quality Branch (NAQUADAT). The locations at which these data have been collected are presented by river basin and are listed in sequence from the headwaters to the Mouth of the basin. Presented for each sampling site is the reference number under which the data is filed, the geographic co-ordinates, the approximate number of samples on file and the time period during which the samples were collected. The frequency at which samples have been collected varies from daily to only four times per year depending on the study for which the samples were collected. In general, most samples have been collected on a monthly basis. Similarly, the analyses carried out on the samples varies significantly. Some samples have been analysed for only a few constituents while others have been analysed for more than 100 constituents. At most locations, data are available for major ions, nutrients, metals and physical parameters. At selected sites, results for insecticides, herbicides, coliform bacteria and biological constituents may also be available.

064736
WATER RESOUR BRANCH, ONT MINIST ENVIRON * **Water quality data, Ontario lakes and streams 1980, volume XVI** * Water Qual Data Series * 670p * Ont Minist Environ, Water Resour Branch, Toronto, Ont * 1981.

Data presented in this publication result from a routine sampling program designed to provide a long-term record of water quality information at specific points on rivers and inland lakes in Ontario. The information is used by the Ontario Ministry of the Environment to maintain surveillance over water quality and to provide supporting data used in the analysis and prediction of water

quality for planning and other purposes. Microbiological, chemical, physical, radiochemical and synthetic organic analyses are conducted at the laboratory. The water quality monitoring program commmenced in July 1964 in Southern Ontario and currently consists of a total of 736 stations throughout Ontario.

062037
WHITFIELD PH * **Evaluation of water quality sampling locations on the Yukon River** * Water Resour Bull * 19(1) 115-121 * 1983-02.

This paper presents an approach to the evaluation of water quality sampling locations for their potential use for long term monitoring. This approach was applied to four sites on the Yukon River near the Canada-United States boundary. At three of these sites it was difficult to obtain representative samples due to the presence of extensive lateral heterogeneities. These heterogeneities occur because of a lack of mixing between the Yukon River and the major tributaries upstream from Dawson. Only one of the sampling locations is spatially homogeneous enough to provide representative samples. Concentration variations over the annual cycle are very large, often as much as two orders of magnitude. Estimates are made of the frequency and density with which samples must be collected to be able to detect a 10 percent different between annual mean concentrations. The estimated frequencies are so large that such an undertaking would be impractical. More importantly, the assumptions of this analysis are invalid, and time series analysis of fixed frequency samples is proposed as an alternative that is statistically rigorous and requires fewer samples.

4.16.4 Acidification - Acidification

065696
BARRINGER MAGENTA LTD * **Study on effects of acid water on leaching of metals from domestic water supplies** * Natl Water Res Inst Unpublished Manuscr #83-26 * 32p * Environ Can, Natl Water Res Inst, Can Cent Inland Waters, Burlington, Ont * 1983-03.

Laboratory studies of the effect of pH, temperature and hardness on the leaching of metals from domestic plumbing materials are completed. The results indicate that significant changes occur in new pipe material during the first few weeks of contact with water. Decreasing pH results in increased rates of leaching of metals, principally lead, copper and zinc, from piping materials. A decrease of pH from 8 to 6 can result in substantial increases in the leaching of lead and copper from the most widely used plumbing material, soldered copper pipes. The effect of temperature is slight, up to 30 C, for all metals, except lead. No significant difference between soft and hard water was observed at pH 8.0. A survey of 105 sites in the Toronto area was completed and showed some good correlations with the results of the laboratory study, particularly the effect of a lowering of metal concentrations after flushing the water system compared to levels in standing water. Only lead was found at concentrations higher than the recommended level, at some sites, and then, only in the standing samples. The pH values in all of the samples were essentially the same, as were the hardness levels, and this precludes any statistical analysis of these parameters. The effects of pH, and hardness, on field samples must thus await further survey work.

064595
BJERLE K, HOGBERG E, SVERDRUP H, WARFVINGE P, OSTENSSON P * **Liming of running water compendium** * Can Transl Fish Aquat Sci 4995 * 86p * Fish Oceans Can, SIPB * 1983.

A symposium on the liming of running water was held in Alvestad, Sweden on May 18, 1983. Papers were presented on the liming strategy for running water, examination of cost factors for various liming techniques, introduction of limestone as material and a presentation of test installations including a liming well, feeder installations and a discussion of the performance of different feeding techniques.

065067
BOBEE B, GRIMARD Y, LACHANCE M, TESSIER A * **Evaluation of acidification level of lake water: application of existing models** * Can Transl Fish Aquat Sci 5014 * 42p * 1983.

This chapter applies different mathematical models to the data on Quebec lakes to study the extent and intensity of acidification.

065066
BOBEE B, GRIMARD Y, LACHANCE M, TESSIER A * **Descriptive analysis of the changes in chemical parameters related to acidification of lake waters** * Can Transl Fish Aquat Sci 5013 * 31p * 1983.

On the basis of data, an attempt has been made to analyze and interpret the variability of the most important parameters and indices related to the acidification of lake waters. The importance of seasonal variations was evaluated by comparing spring and summer data. Then the spatial evolution of each of the retained parameters was examined in an attempt to determine the major spatial characteristics required to understand and evaluate the extent of acidification of Quebec lakes.

064761
BOBEE B, LACHANCE M * **A method for analyzing data on lake acidification and its application in Quebec, Canada** * Water Qual Bull * 160-167

* WHO Collaborating Cent on Surface and Ground Water Qual, Can Cent Inland Waters, Burlington, Ont * 1983-07.

Acid precipitation - better known as acid rain - is considered by scientists to be one of the gravest environmental perils at the present time. The part of Quebec located on the Canadian Shield has often been identified as one of the most sensitive regions. Through statistical analysis of data on 149 lakes in the Canadian Sheild region of Quebec, a general picture was obtained of the spatial variability in that region of a set of parameters related to the acidification of lakewaters. On that basis, zones were selected which are highly vulnerable to acid precipitation and zones whose lakes show clear signs of acidification resulting from such precipitation. Multivariate statistical techniques proved useful in bringing out major differences in lake chemistry. The results of the analysis constitute a first step in the direction of a more detailed knowledge of areas of Quebec. The techniques used for testing are given.

F12028
BROUARD D, LACHANCE M, LANGLOIS C * **Qualite physico-chimique printaniere des eaux de surface et des precipitations dans le secteur amont de la riviere des Escoumins** * Rapp tech can sci halieut aquat no 1228 * 39p * Minist Peches Oceans, Dir rech peches, 901 Cap Diamant, CP 15 500, Quebec, Que G1K 7Y7 * 1983-12.

Cette etude, effectuee au cours du printemps 1982, est une continuation des travaux entrepris en 1981, lesquels ont mis en evidence la haute sensibilite a l'acidification de quatre rivieres a saumons de la Cote-Nord du Saint-Laurent. La presente etude permet de mieux preciser l'influence des conditions hydrometeorologiques printanieres sur les variations journalieres de la qualite physico-chimique des eaux dans le secteur amont de la riviere des Escoumins. Au cours des mois de mars et avril, des echantillons d'eaux de surface ont ete preleves journalierement a trois stations localisees sur le troncon principal de la riviere des Escoumins, ainsi qu'a trois stations situees sur des tributaires de faible superficie de drainage. L'analyse statistique des interrelations entre stations pour les parametres chimiques mesures (notamment les sulfates, l'alcalinite, le pH et l'aluminium), a montre que le phenomene de fonte printaniere est apparent a toutes les stations quoiqu'a des niveaux differents. Les stations situees sur le troncon principal de la riviere ont des comportements similaires, tandis que les tributaires qui possedent un petit bassin de drainage sont sujets a des fluctuations beaucoup plus importantes dans la qualite de l'eau. De plus, ces conditions particulieres qui prevalent sur les petits tributaires peuvent difficilement etre extrapoles a partir de l'information recueillie sur le troncon principal du meme cours d'eau, car elles sont beaucoup plus reliees a des evenements de nature episodique associes a la fonte des neiges. Certaines conditions observees, notamment les fluctuations de pH, d'alcalinite et d'aluminium, laissent presager un risque potentiel a plus ou moins long terme pour les salmonides, en particulier dans les tributaires de faible superficie de drainage.

066900
CAMPBELL PGC, BISSON M, BOUGIE R, TESSIER A, VILLENEUVE JP * **Speciation of aluminum in acidic freshwaters** * Anal Chem * 55(14) 2246-2252 * 1983-12.

The determination of the physical speciation of aluminum in water samples by filtration through polycarbonate membranes proved feasible; control experiments revealed neither contamination nor analyte loss. Treatment of sample filtrates with a fractionally loaded Chelex 100 ion-exchange resin (greater than 75% H+ form) allows one to distinguish between different forms of aluminum on the basis of their kinetic and thermodynamic properties. Monomeric hydroxo- and fluoroaluminum complexes exchanged readily (greater than 85% after 30 min), as did low molecular weight polynuclear species. Under similar conditions, forms of Al associated with fulvic and humic acids of natural origin exchanged much more slowly (less than 5% after 30 min, at an Al:dissolved organic carbon atomic ratio of approximately 1:155). Before photooxidation, the filterable aluminum present in natural waters exhibited intermediate behavior (1-50% exchange after 30 min); after UV irradiation the nonexchangeable Al fraction had practically disappeared (90-96% exchange after 30 min), suggesting that the major portion of the nonexchangeable Al initially present was associated with organic matter.

064062
CHARETTE JY * **The acidification of surface water** * 3p * 1982.

The acidification of lakes, with emphasis on Quebec, and the associated changes in water quality, are described. The use of the Henriksen model, a model based on the principle that under natural conditions calcium concentration is associated with a specific degree of acidity, to lakes in southern Quebec showing a strong relationship between the acidity of precipitation and the acidification of lakes, is discussed. The activities of the Inland Waters Directorate (IWD), specifically in calibrated watershed studies and environmental impact assessment studies, are outlined. Emphasis is placed on the calibrated watershed study of the Lake Laflamme Basin, Quebec, which determined quantitatively and qualitatively the response of the aquatic ecosystems of the boreal

forests to air pollutants. Other IWD activities discussed are: a study of monthly variation in water quality for 22 lakes in La Mauricie National Park; determination of the condition of headwater lakes in southern Quebec by means of quality sampling; and, development of an analysis technique to efficiently identify and measure toxic forms of aluminum.

F10738
CONS NATL RECH CAN * **Acidification dans l'environnement aquatique au Canada: criteres scientifiques pour evaluer les effets du depot acide sur les ecosystemes aquatiques** * CNRC no 18476 * 377p * Cons natl rech Can, Ottawa, Ont * 1981.

Le depot acide (appele communement "pluies acides") suscite de graves inquietudes dans pluieurs pays, notamment au Canada, aux Etats-Unis et dans le nord de l'Europe. Il devient de plus en plus evident que les modifications locales de la pollution des airs ou de l'eau ne sont pas seules a l'origine de l'alteration des ecosystemes d'eaux fraiches. On sait maintenant que les substances acides peuvent etre transportees tres loin dans l'atmosphere (ou les oxides d'azote et de soufre sont transformes en materiaux acides) et que leur depot contribue a acidifier les eaux qui les recoivent. Diverses modifications interconnexes -- physiques, chimiques et biologiques -- suivent le depot de ces substances acides sur un terrain sensible. En fait, une grande superficie dans l'est de l'Amerique du Nord est exposee aux depots acides et on a identifie plusieurs regions dans l'ouest de notre pays et dans l'ouest et le sud des E.-U. comme etant tres susceptibles a l'action de ces depots. Un groupe d'experts a ete convoque par le Comite associe du CNRC sur les criteres scientifiques concernant l'etat de l'environnement, afin d'evaluer les donnees scientifiques disponibles sur les rapports cause/effet du depot acide dans l'environnement aquatique au Canada. Le groupe a etudie notamment: (1) transport atmospherique, transformation et depot (2) aspects geochimique, biologique et hydrologique du depot acide (3) effets de l'acidification sur la chimie des eaux de surface et sur les micro-organismes, phytoplancton, macrophytes, zooplacton, organismes benthiques, poissons, amphibiens et oiseaux aquatiques. En outre, les experts ont evalue des etudes sur le bilan chimique des bassins hydrographiques, la manipulation experimentale de lacs entiers et la repartition de l'acidite dans les terrains sensibles au Canada. Les experts ont conclu que les interactions suivant le depot des substances acides posent des problemes aux environnements aquatiques du pays. Toutefois, on ne saurait evaluer exactement l'etendue et la portee du probleme avec les donnees disponibles actuellement. Ayant identifie d'importantes lacunes dans les connaissances actuelles, les experts proposent une serie de recommandations pour obtenir les donnees qui nous manquent.

F12100
DANDURAND J, POULIOT S, LATENDRESSE C, CAMPBELL J * **Diagnose ecologique d'un lac sensible aux precipitations acides dans le bassin du lac Kempt, Que.** * 46p * Ec Polytechnique Montreal, Campus Univ Montreal, CP 6079, Succ "A", Montreal, Que H3C 3A7 * 1983.

Cette etude evalue le potentiel offert par le bassin versant du lac Menomini en tant que site d'etude sur les effets des precipitations acides en milieu naturel. L'evaluation se base sur une diagnose ecologique du lac, effectueee au cours des mois de juillet et aout 1983, comprenant les aspects suivants: la morphometrie du lac, la physico-chimie de l'eau, un inventaire semi-quantitatif de la vegetation aquatique, un inventaire qualitatif de la faune ichtyologique ainsi que la description des tributaires et de l'emissaire. La caracterisation preliminaire de ce bassin versant de taille requise permet de considerer celui-ci comme un site potentiel d'etudes. Par contre, mentionnons que parmi les petits lacs etudies precedemment, le lac Coregone pourrait egalement constituer un site d'etude interessant.

F11561
DELISLE CE, BILODEAU P, ROY L, ANDRE P * **Acidification artificielle en enclos limniques au lac Kempt: resultats preliminaires** * Sci Tech Eau * 16(4) 367-369 * Assoc quebecoise des tech de l'eau, Montreal, Que * 1983-11.

L'effet de l'acidification sur l'ecosysteme aquatique a ete etudie au lac Kempt (Quebec, Canada), a l'aide d'enclos limniques. Les auteurs decrivent les enclos utilises et y suivent l'evolution des parametres physico-chimiques. Les pH experimentes par l'ajout de H2SO4 sont de 4.0, 5.0 et 5.5. Les principales conclusions sont: la facilite a maintenir le pH au niveau desire; l'augmentation de la conductivite et du CO2-libre avec l'acidification, accompagnee de la baisse de l'alcalinite totale; l'augmentation significative de la concentration de Mn, Cd, Fe et Cu en milieu acidifie et l'augmentation, mais de moindre importance, du Zn, Al et Pb. Une esquisse est finalement brossee des principales modifications apportees aux peuplements planctoniques.

F12099
DELISLE CE, BOUCHARD MA, ANDRE P, BILODEAU P, GRANDCHAMPS B, GOUTHIER F, ROY L * **Evaluation de la sensibilite du Nouveau-Quebec a l'acidification** * 134p * Ec Polytechnique Montreal, Campus Univ Montreal, CP 6079, Succ "A", Montreal, Que H3C 3A7 * 1984-01.

Le present rapport d'etape fait etat des travaux la periode du projet s'etendant du 1er janvier 1983 au 30 septembre 1983. Une station collectrice des precipitations de type semi-automatique a ete installee a Inujjuaq (58 50' Lat. N) a la fin du mois d'avril 1983. L'analyse de douze (12) evenements pluviaux, couvrant la periode du 2 mai au 9 aout 1983 permets les observations et les conclusions suivantes: le pH des precipitations varie de 4,19 a 5,43 avec une valeur moyenne de 4,94; les concentrations en sulfates les plus eleves, atteignant 75 micro gli, coincident avec les evenements acides; les auteurs en concluent que des precipitations acides atteignent presentement la region d'Inujjuaq et qu'une partie de ces evenements sont probablement d'origine anthropique. Un releve des conditions geologiques, ainsi que de divers autres parametres environnementaux sur le terrain permettent de conclure a la grande sensibilite de la region aux precipitations acides. Douze lacs ont ete etudies en details sur le terrain. Ces sites se situent au voisinage des villages de Kuujjuraapik, Inujjaq et Salliut. Les sites et lacs etudies sont illustres sur 7 cartes qui accompagnent ce rapport.

066526
DICKMAN M, DIXIT S, FORTESCUE J, BARLOW B, TERASMAE J * **Diatoms as indicators of the rate of lake acidification** * Water Air Soil Pollut * v21 375-386 * 1984-01.

Autecological studies of diatoms as pH indicators have opened the way to estimating a lake's past pH on the basis of its diatom species composition and relative abundance. Estimating the rate of lake acidification from its sediment subfossil diatoms is possible when these subfossils can be identified and accurately enumerated in the surface sediments of 20 to 30 lakes. Once this is done the diatoms down the length of the sediment core of one or more of these lakes can be enumerated and the pH inferred at each depth. This technique holds considerable promise in assessing the temporal impact of acid precipitation for acid-sensitive lakes. When log alpha values were regressed against observed pH for 28 lakes located north of Lake Superior, a significant (P is less than 0.01) correlation (r = 0.89) resulted. Downcore diatom stratigraphy for one of these lakes indicated that its pH had dropped from 6.2 to 5.2 over the last 20 yr while a second lake had dropped from a pH of 7.1 to 5.2 over the last 30 yr.

065290
EILERS JM, GLASS GE, WEBSTER KE, ROGALLA JA * **Hydrologic control of lake susceptibility to acidification** * Can J Fish Aquat Sci * 40(11) 1896-1904 * 1983-11.

Two hundred and seventy-five lakes were sampled in the summer of 1979 to assess the factors controlling susceptibility of northcentral Wisconsin lakes to acidification. In addition to direct evaluation of means and ranges of the physical and chemical characteristics, a cluster analysis emerged that appeared to be controlled by hydrology: A - dominated by surface runoff; B - dominated by groundwater; C - dominated by precipitation. Relationships between morphometric, hydrologic, and terrigenous factors that can influence lake water quality and susceptibility were further examined by discriminant analysis of 18 watershed properties across the three lake clusters. Hydrologic factors were most important in differentiating the low alkalinity and high alkalinity lakes. The potentially sensitive low alkalinity lakes in northcentral Wisconsin lack surface inlets or outlets and their chemistry is closely associated with precipitation chemistry.

062971
ELLIS JD, GOLOMB A * **Lake acidification and its neutralization** * Ont Hydro Res Rev * (2) 67-74 * Ont Hydro, 800 Kipling Ave, Toronto, Ont M8Z 5S4 * 1981-05.

The literature dealing with the effects of acid deposition on aquatic ecosystem and with documentation of the efficacy of neutralization as a lake restoration technique is reviewed. A considerable body of inferential evidence exists that would suggest that acid deposition is having a detrimental effect on the chemistry and biology of acid-sensitive lakes. Lake neutralization experiments have been only partly successful in restoring low-pH lakes to a non-acid-stressed oligotrophic state.

065709
FERRONI GD, LEDUC LG, CHOQUET CG * **Preliminary studies on the use of the heterotrophic activity method to evaluate acid-stress effects in aquatic environments** * Water Res * 17(10) 1379-1384 * 1983.

--This paper concerns the usefulness of the "heterotrophic activity method" in studying the effects of acidification on mineralization activity in a lake in which acid rain is simulated, and in an acid-stressed lake. In the fall, the rates of glucose mineralization by the planktonic microflora of Bethel Lake followed Michaelis-Menten kinetics at the #ibin situ#ie pH (7.5) and at the two experimental pH's (5.5 and 5.0). Turnover times for glucose increased with decreasing pH and, correspondingly, V sub max values decreased with decreasing pH. During ice-cover, only the #ibin situ#ie pH (6.85) gave a Michaelis-Menten response for glucose mineralization. At the experimental pH's, glucose mineralization activity was negligible. Analyses for soluble copper and nickel, the most important heavy metals in this environment with respect to

concentration, indicated that the reduced glucose mineralization rates were not the result of our acidification increasing the heavy metal concentrations (and, therefore, their toxicity). For the acid-stressed Silver Lake, glucose mineralization was negligible at the #ibin situ#ie pH (4.3) and at the experimental pH's (5.5 and 7.0) as well. The application of this method in the study of acid-stressed lakes is discussed.

063441
GALLOWAY JN, SCHOFIELD CL, PETERS NE, HENDREY GR, ALTWICKER ER * **Effect of atmospheric sulfur on the composition of three Adirondack lakes** * Can J Fish Aquat Sci * 40(6) 799-806 * 1983-06.

Three watershed - lake systems of the Integrated Lake - Watershed Acidification Study (ILWAS) were investigated to determine the effects of atmospheric deposition on the chemical compositions of oligotropic lakes in the Adirondack Mountains of New York. Using the principles of watershed mass balance and electroneutrality of solutions, the following conclusions were drawn. (1) Annually, about 90% of the NH4 sup (+) and 50% of the NO3 sup (-) from atmospheric deposition were retained in the systems. (2) In the Woods system, Cl sup (-) was in steady state with respect to atmospheric deposition although both Panther and Sagamore systems had net losses, indicating watershed sources of Cl sup (-). (3) The losses of base cations from Panther and Sagamore were substantially greater than from the Woods system, reflecting the shallow soils of the latter. (4) The concentrations of SO4 sup (2-) in the waters of the three systems were controlled by the atmospheric deposition of anthropogenic sulfur; in Woods and Panther, inputs (atmospheric deposition) equalled outputs (discharges from the lake outlets); in Sagamore, outputs exceeded inputs. (5) In 1978-80, concentrations of SO4 sup (2-) were four to five times higher than historical values.

065241
GRAY JE, KELSO JRM * **An examination of historical lake and stream chemistry in north-central Ontario - can a case be made for acidification?**
IN: Proc of the thirty-sixth meeting of the Canadian Conf for Fisheries Research, held at Winnipeg, Jan 3 and 4, 1983 * p60 * Dep Fish Oceans, Resour Serv Dir * 1983-01.

Documentation of the acidification of lakes and streams using historical chemical records has provided useful estimates of changes through time in Canada. Yet, the impact of the long range transport of atmospheric contaminants on remote inland lakes and streams still remains generally uncertain. Two unique historical limnological records, the Ontario Ministry of Natural Resources lake inventory data and the Ontario Ministry of the Environment's stream water quality data lend themselves to trend through time analysis and were consistently examined through multiple regression, factor, principal-component and discriminant analyses to determine factors influencing chemical response. However, as a result of inconsistent sampling and analytical methods over twenty years, no significant trends-through-time were observed for a population of 117 lakes and 33 streams. The lakes had wide morphological characteristics with a mean area of 2.3 sq km, watershed area 29.2 sq km, and a mean depth of 9.8 m. The streams watersheds ranged from 238 sq km to 9040 sq km. These results should be treated with caution as these data bases were not designed to examine acidification in freshwater environments and methodological problems may obviate this type of approach for assessing acidification of lakes or streams.

064892
KELLER W * **Spring pH and alkalinity depressions in Lake Superior tributaries** * J Great Lakes Res * 9(3) 425-429 * 1983.

Between October 1980 and October 1981, the pH and alkalinity of 21 Canadian Lake Superior tributaries were measured. All tributaries studied exhibited reductions in pH and alkalinity during the spring runoff period of 1981; two showed pH minima of near 5.0 and an additional five showed pH minima in the range of 5.5 to 6.0. Since most of these waters constitute valuable fishery resources, particularly for salmonids, the observed pH depressions prompt concern over possible effects on fish populations.

065555
KELSO JRM, MINNS CK * **Current status of lake acidification and its effect on the fishery resources of Canada** , IN: Acid rain/fisheries, Proc Int Symp on Acidic Precipitation and Fishery Impacts in Northeastern North America, Ithaca, NY, 2-5 Aug 1981 * HAINES TA (chairman) * 69-81 * Am Fish Soc, Northeast Div, 5410 Grosvenor Lane, Bethesda, MD 20814 US * 1982.

Whereas only small areas of the United States are sensitive to mineral acid loadings, most of Canada east of Manitoba is underlain by the Canadian Shield, which has limited capacity to counteract acid deposition. In Canada, most acidification results from a few large primary smelting operations; power generation, industrial activities, home heating and transportation contribute as well. Deposition is increasing through time, and the area with high deposition rates is spreading. In southern Ontario pH values as low as 4.03 have been found. The integration of lithology and glacial deposits has been used to derive maps of potential ecosystem sensitivity to acid deposition. Fisheries can be affected by acid conditions, either by direct mortality, or by alterations to the population's well-

being from an adverse effect upon early life stages. Fish communities are lost at a point in the acidification process. Minns devised an acid stress/lake sensitivity procedure based on precipitation pH, lake conductivity, and lake pH. Lakes were classified by stress, sensitivity, and watershed, and then sorted into 20 fish community categories, depending on presence or absence of key gamefish species. Results indicate large areas of lakes under stress. Anadromous stream-spawning Atlantic salmon is threatened by atmospheric deposition of contaminants. Large numbers of eastern Canada's lakes are easily classified as sensitive. As acidification occurs in lakes, pH shifts downward in sensitive ecosystems and the number of lakes without fish increase. This phenomenon has been seen already in Ontario.

F11730
LANGLOIS C, VIGNEAULT Y, NADEAU A, DESILETS L * **Evaluation des effets de l'acidification sur la physico-chimie et la biologie des lacs du bouclier Canadien (Region du Quebec)** . IN: Proc of the thirty-sixth meeting of the Canadian Conf for Fisheries Research, held at Winnipeg, Jan 3 and 4, 1983 * p63 * Dep Fish Oceans, Resour Serv Dir * 1983-01.

Dans le cadre du programme national d'inventaire des lacs, Peches et Oceans, Region du Quebec, a realise durant les etes 1981 et 1982 un echantillonnage de 200 lacs pour analyse physico-chimique dont 50 avec inventaire biologique (poissons, plancton, benthos, sediments, vegetation aquatique et bathymetrie). Les objectifs poursuivis sont d'une part d'identifier sur le territoire quebecois les regions affectees par le transport a grande distance des polluants atmospheriques (TGDPA) et d'autre part d'inventorier les populations de poissons et de caracteriser leur habitat en egard aux effets du TGDPA. A partir de l'analyse multidimensionnelle des resultats physico-chimiques, neuf groupes de lacs ont ete identifies quant a leur similarite du point de vue de la qualite de l'eau. Parmi les parametres mesures les plus discriminants selon la methode d'Analyse en Composantes Principale sont le pH, le SO4 exposant -2, l'aluminium, la couleur, les parametres de mineralisation (conductivite, alcalinite, calcium, magnesium et potassium) et le manganese.

O66859
MAYER T * **Distribution of iron - phosphate species in acid-stressed soft water lakes** * NWRI Unpublished Manuscr Numbered Ser 83-2 * 15p * Environ Can, Natl Water Res Inst, Burlington, Ont L7R 4A6 * 1983-07.

The objective of this work was to establish the distribution of iron-phosphate species in acid-stressed soft water lakes and to examine the mechanism of phosphate removal from the water column. Results of this work provide an approximate estimation of orthophosphate species present in the water in the free and complexed form. Since the free orthophosphate species is utilized by phytoplankton and macrophytes preferentially, a useful information about the availability of this nutrient can be implied.

O64884
OLIVER BG, KELSO JRM * **A role for sediments in retarding the acidification of headwater lakes** * Water Air Soil Pollut * 20(4) 379-389 * 1983-11.

Experiments conducted on selected minerals and headwater lake sediments showed that major acid neutralization reactions above pH 4.5 were reactions releasing $Ca^{2+} + Mg^{2+}$ from the sediments. Analysis of the sediments and water from 97 headwater lakes in northern Ontario showed a predictable decrease in the exchangeable $Ca^{2+} + Mg^{2+}$ of the sediments with decreasing lakewater pH. Estimates of the total potential buffering capacity for the sediments above PH 4.5 and for water in these headwater lakes were made, and it was found that, even when only the top 1 cm of sediment is considered, a substantial sediment buffering reserve is available.

F10625
PECHES OCEANS, DIR COMMUN * **Les pluies acides** * MPO/503 1982/10F * 16p * Peches Oceans, Dir commun, Ottawa, Ont * 1982.

Bien que l'on commence seulement a decouvrir beaucoup d'effets lies aux pluies acides, on connait tres bien leurs repercussions sur le poisson. Les principales regions actuellement affectees comprennent: la Nouvelle-Ecosse; l'Ontario; le Quebec et le Labrador; Terre-Neuve et le Nouveau-Brunswick. Le probleme des pluies acides est un probleme nord-americain. Il ne sera resolu que si nous travaillons ensemble afin d'assurer une ferme collaboration entre les gouvernements federaux des deux pays et ceux des Etats et des provinces. Il nous faut mobiliser la volonte politique de controler les emissions d'oxydes de soufre et d'azote a la source. C'est ca le seul moyen vraiment efficace de resoudre le probleme.

O65536
SCHINDLER DW, RUSZCZYNSKI T * **A test of limnological data from the Experimental Lakes Area, northwestern Ontario, for evidence of acidification** * Can Tech Rep Fish Aquat Sci 1147 * 21p * Dep Fish Oceans, West Reg, Winnipeg, Man * 1983-02.

Two older (1967 and 1973) data sets were compared with 1978 survey information in order to detect possible acidification of lakes near the Experimental Lakes Area of northwestern Ontario. An error in analysis or calculation in the 1973 data set precluded reliance on

measured alkalinity, the most sensitive indicator of lake acidification. Calculated alkalinity, conductivity and pH showed no conclusive evidence of acidification, although watershed modifications, both human and natural, during the period provided confounding influences on the parameters examined. Long-term data sets for several lakes also showed no conclusive evidence of acidification due to precipitation of current pH values (average pH 4.9-5.0).

065082
SCRUTON DA * **A survey of headwater lakes in insular Newfoundland, with special reference to acid precipitation** (see chapter 3.2 for complete reference - voir chapitre 3.2 pour la reference complete)

F10747
SPEAR PA * **Le zinc dans l'environnement aquatique: chimie, repartition et toxicologie** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

067181
STOKES PM, BAILEY RC * **A biological monitoring system for metals in acid-stressed lakes** , IN: Int Conf Heavy Metals in the Environment, Heidelberg, September 1983 * Mueller G (chairman) * 1049-1052 * CEP Consult Ltd, 26 Albany St, Edinburgh EH1 3QH GB * 1983.

Chemical changes in lakes subject to acidic precipitation result in increased concentration and alterations in speciation of metals. With the exception of pH-related aluminum toxicity and mercury accumulation in fish, the effects on the biota are largely unknown. In softwater lakes in Ontario and Quebec, we have evaluated the filamentous algal community as a monitor of Cu, Hg, Pb, Mn, Al and Zn. Principal components analysis was used to determine major axes of variation in subgroups of environmental and biotic variables. For most metals, algal concentrations were positively correlated with metals in water, metals in sediments, conductivity and major cations, and negatively correlated with pH. The algae are proposed as monitors of available metals, especially in situations where lake neutralization or restoration is being attempted, and where fish stocking is anticipated.

064594
SVERDRUP H, EKLUND H, BJERLE I * **Liming of running water - experience from a fluidizing lime-bed mover** * Can Transl Fish Aquat Sci 4994 * 9p * Fish Oceans Can, SIPB * 1983.

An example at Tjurken Lake, Sweden is described to demonstrate that fluidized lime-beds may constitute an effective solution for liming running waters.

064593
SVERDRUP HU * **Optimization of liming of acid waters** * Can Transl Fish Aquat Sci 4993 * 7p * Fish Oceans Can, SIPB * 1983.

An application of knowledge of limestone dissolution to the liming of acid water in Sweden yields mathematical formulas for dissolution. Liming efforts should aim at a good liming efficiency and economy.

066768
UNDERWOOD JK, HINCH PR, VAUGHAN HH, OGDEN JG, MANN CG, KEREKES JJ * **Acidification of Nova Scotia lakes** * 4v * NS Dep Environ, Box 2107 Halifax, NS B3J 3B7 * 1982-11.

These four reports deal with the phenomenon of acidification of lakes in Nova Scotia, how it is measured and some of its effects. The first volume in the series is an annotated bibliography of 38 titles. These references provide information on the purpose of the study, the number of lakes studied, the parameters measured and method of analyses, the date of the study, the results observed and the relevance to acidification processes. The second volume examines the acidification processes in lakes which occur on metamorphic or igneous bedrock by means of the Henriksen monograph. The authors determine that this treatment of the data is unsuitable for such dilute lakes. Volume three deals with the patterns of SO4+ and NO3-N deposition from the atmosphere in Nova Scotia from 1977 to 1980. The mean annual deposition was greater in the southwest portion of the province (47 meq SO4+ per meter squared per year and 21 meq NO3-N per meter squared per year) compared with the northeast (38 and 13 respectively). Precipitation pH grades from 4.5 to 4.8 along the same axis. Almost 50% of SO4+ deposition occurred when wind blew from the southwest. The chemistry of Nova Scotia lakes was interpreted as exhibiting the same general trend as that for atmospheric deposition. In addition, comparisons of rural with urban lakes demonstrate a positive relationship between SO4+ concentrations and increasing proximity to the centre of the Halifax metro area. The final volume reports the analyses of lakes for historical changes in diatom assemblages to acidification. In the most recent sediments of the rural lakes examined, diatom assemblages exhibit two distinct types of responses: a)rates of indicated acidification in urban lakes over a period of a decade resemble those observed in clearwater rural lakes over a period of 3-5 decades; b)in historically acidic coloured lakes, diatom assemblages indicate a decreased acidification over a similar time period. This is believed to reflect the tendency of organic acids to dominate pH variation.

065242
WATT WD, SCOTT D, WHITE WJ * **Evidence of acidification in some Nova Scotia rivers and**

of impact on Atlantic salmon, Salmo salar, IN: Proc of the thirty-sixth meeting of the Canadian Conf for Fisheries Research, held at Winnipeg, Jan 3 and 4, 1983 * p69 * Dep Fish Oceans, Resour Serv Dir * 1983-01.

River pH's in Nova Scotia are closely related to geology, and seasonal pH variation is well correlated with river discharge rates. In the geologically sensitive areas of granite and metamorphic rocks, the river pH's have fallen significantly over the past 27 years at an apparent average rate of -0.017 pH units/year. Concomitant with this are a decline in HCO- concentrations and increases in Alttt and SO=4. On average, 73% of the increase in acid ia attributable to increased SO4. There were no significant changes in Na+, K+, Ca++ and Mg++ concentrations. In rivers presently at pH's less than 4.7 and the Atlantic salmon runs have disappeared and are presumed extinct. Rivers in the pH range 4.7 - 5.0 show a decline in salmon angling returns (-2.5%/year) beginning about 1954, and low densities of juvenile salmon. Rivers presently of pH more than 5.0 generally have normal juvenile densities and show no significant trend in angling returns.

F10850
WHELPDALE DM * **Depots acides: repartition et incidences** * Bull qual eaux * 8(2) 73-80,109 * Cent collab pour la qual eaux, Cent can eaux inter, Burlington, Ont * 1983-06.

Cet article porte sur les caracteristiques, la repartition et l'incidence des depots acides. Il consiste en une breve etude des substances acides et des mecanismes de depot, une analyse de l'importance et des caracteristiques spatiales des depots acides ainsi qu'un apercu de quelques-uns des effets les plus graves.

4.16.5 Temperature - Temperature

065119
ANDERSON RR * **Thermal pollution and variation in stream algae species** * 17p * (1980).

In streams fresh water algae react to artificially increased water temperature. This is manifested in ways similar to ponds, lakes and springs; that is a few species proliferate while the majority are eliminated or greatly reduced in number. In effect this is similar to other forms of pollution (i.e. eutrophication). In this study it was evident that thermal pollution, by providing a stable environment favorable to a few species, negates to some extent seasonal changes such as photo period, water level, nutrient level and most significantly temperature changes. The total mass of algae is greatly increased while the number of species is reduced. Macroscopic species such as chara can become established where normally changing water levels and temperature changes would prevent them becoming established. In the stream surveyed, the effects are not serious since the volume of water involved is not a large percentage of the stream volume. The rapid current mixes the water effectively and as a result only a relatively short portion of the river is affected. If, however, the volume of warm water was great enough, or the temperature difference between the normal stream and the heated water was large enough the probability of serious problems is evident.

066932
BOYCE FM, ROBERTSON DG, IVEY GN * **Summer thermal structure of Lake Ontario off Toronto: cooling the big city** * Atmos-Ocean * 21(4) 397-417 * 1983-12.

It has been proposed that large savings in electrical energy are possible if cool, deep water from Lake Ontario is used, as an alternative to electrically operated chillers, to provide the cooling requirements of large buildings in down-town Toronto. In order to estimate the capital expenditure involved, it is necessary to determine how deep (and how far offshore) the cold water intake must be placed to obtain a reliable supply of cool water throughout the air-conditioning season. Temperature profile data, collected during ship surveys over the past twenty years in Lake Ontario off Toronto, plus time-series data from a 21-level thermistor array installed on the 100-m contour near the site of the proposed intake during the summer of 1980, have been used to answer this specific question. The two sets are examined to determine the relative importance of thermal variability for inter-annual, seasonal, and shorter time-scales. Intake design turns out to be an important consideration for the air-conditioning scheme. Unless azimuthal swirling velocities are restrained at the intake, drawdown of warmer thermocline water into the intake may occur.

062896
CHAUDHRY MH, CASS DE, EDINGER JE * **Modeling of unsteady-flow water temperatures** * J Hydraul Eng * 109(5) 657-669 * 1983-05.

A mathematical model is presented to simulate water temperatures of one-dimensional unsteady flows in a river-lake system having time-varying lateral inflows and several cross-sectional changes along its length. In the hydraulic part initial steady state conditions are computed by numerically integrating the gradually-varied flow equation using the fourth-order Runge-Kutta method and the unsteady flow conditions by integrating the one-dimensional Saint Venant equations using an implicit finite difference method. An upwind implicit finite difference scheme is used to solve the partial differential equation governing the water temperature of unsteady flows. Comparision of the computed

water temperatures with those measured on the Columbia and Kootenay Rivers show good agreement.

064534
CHORNEY RJ, SHERWOOD RL (ED) * **Geothermal electric energy and its impacts on the environment** * Reg Program Rep: 81-05 * 37p * Environ Prot Serv, Pac Yukon Reg, Environ Can * 1981-09.

An overview of various geothermal systems and their possible utilization is first provided. This is followed by a detailed summary from the available literature of the various environmental impacts of geothermal electric energy projects. The pollution potential to water, air and soil is described as well as the possibility of thermal and noise pollution. Other environmental concerns discussed include land subsidence, induced seismic activity, land alienation, habitat disturbance and well blowouts.

064400
CHRISTIE AE * **The calculation of temperature guidelines to protect fish resident in the Ottawa River: a predictive model** . IN: International Association of Theoretical and Applied Limnology, Proceedings, UP, 1980 * SLADECEK V * 21(2) 1238-1243 * E Schweiz Verlagsbuch handlung, D-7000 Stuttgart 1, DE * 1981.

Thermal criteria, calculated from a modified approach of a methodology developed by the U.S. Environmental Protection Agency, are described, considering the sensitivities of fish growth, reproduction and winter survival to short exposures of extreme temperature changes (MDAT - maximum daily average temperature) and maximum weekly average temperatures (MWAT), are described. A predictive model is developed and presented to establish the upper limit of a temperature increase to the Ottawa River at the outfall of the Chats Falls Hydraulic Station such that no significant change would occur to the composition of the existing fish community. Recommended criteria for MWAT and MDAT are established for releases from the hydraulic station.

F11911
DOBAJ D, CAMARERO R * **Modele numerique pour l'etude des rejets thermiques en riviere** . IN: 6e Conf can d'hydrotechnique, comptes-rendus, 2-3 juin 1983, Ottawa, Ont * TOWNSEND RD * v1 267-286 * Soc can genie civ * 1983-06.

Le modele numerique aux differences finies developpe predit la repartition longitudinale et laterale de la temperature de l'eau d'une riviere subissant l'effet d'un rejet thermique, et fournit l'evolution des isothermes dans le temps. Un scheme implicite aux directions alternees est utilise avec une transformation generale de coordonnees pour une plus grande souplesse dans l'adaption des equations a la geometrie des cas pratiques.

066573
DUNSTALL TG, SCHWARZ CJ * **Effects of temperature elevation and entrainment on heterotrophic uptake of (U-14C) glutamic acid** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

067025
HARTMAN FG, LEAHY RM * **Some temperature characteristics of stream and intra-gravel water in Carnation Creek, British Columbia** * Can Manuscr Rep Fish Aquat Sci 1731 * 40p * Dep Fish Oceans, Fish Res Branch, Pac Biol Stn, Nanaimo, BC V9R 5K6 * 1983-11.

Twenty series of measurements of stream and intra-gravel water temperatures were made in Carnation Creek above the zone of tidal influence during a one year period. The paper discusses the fact that measurements of stream temperatures at specific sites may not indicate very well what the intra-gravel temperatures, at egg incubation depth, may be. Where artificial egg introductions are made and there is a desire to know or control the time of emergence this should be kept in mind. Secondly, the paper discusses the fact that during summer, in a clear-cut area of the stream, water temperatures become progressively lower downstream. The fact that this may occur in some situations should be recognized by fisheries people, evaluating forest harvest impacts.

063690
HOPKINSON RF * **Temperature and evaporation on Lake Diefenbaker, 1981 and 1982** (see chapter 4.15 for complete reference - voir chapitre 4.15 pour la reference complete)

065473
MACKIE GL, ROOKE JB, ROFF JC,GERRATH JF * **Effects of changes in discharge level on temperature and oxygen regimes in a new reservoir and downstream** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

F11049
MARCOTTE N * **Reservoir Bienville etude du regime thermique** (see chapter 4.4 for complete reference - voir chapitre 4.4 pour la reference complete)

064861
SHUTER BJ, SCHLESINGER DA, ZIMMERMAN AP * **Empirical predictors of annual surface water temperature cycles in North American lakes** * Can J Fish Aquat Sci * 40(10) 1838-1845 *

1983-10.

Annual surface water temperature cycles of temperate zone lakes can be adequately described by a symmetrical sine wave of distinct amplitude and duration. The relationships between these sine wave components and climatic and morphometric variables were analyzed for 87 lakes spread over most of North America, and for 25 lakes located in south-central Ontario, Canada. Multiple regression equations are reported which permit estimation of the maximum annual surface water temperature (amplitude: AP) and the number of ice-free days (duration: DR) for a specific lake from data on long-term mean annual air temperature (TEMP), mean depth (Z bar), and fetch (FT). These estimates can be used to calculate mean surface water temperature for just the ice-free period or for an entire year.

061875
WIEGAND RC, CARMACK EC, DALEY RJ, GRAY CBJ, JASPER S, PHARO CH * **Seasonal aspects of the surface and advection heat fluxes of Kootenay Lake, British Columbia** * Water Resour Res * 18(5) 1493-1502 * 1982-10.

A description is given of the heat and water balances of Kootenay Lake, British Columbia. Although the lake has a moderately high throughflow (781 cu m per s), the heat budget is more in character with a lake that is little influenced by rivers. The discussion focuses upon the role of rivers in the termal history of lakes; a contrast is drawn between Kootenay Lake and Kamloops Lake, British Columbia, a strongly riverine lake with a much greater heat budget. It is suggested that the riverine nature of lakes can be characterized using a renewal time that applies to that region of the lake lying above the base of the river plume. Furthermore, the relative roles of advective and surface effects can be qualitatively described using a ratio of surface buoyancy or wind energy to river production of turbulent energy. These parameterizations may prove to be useful descriptors in a lake classification system based upon riverine quality.

063253
YAN ND * **Effects of changes in pH on transparency and thermal regimes of Lohi Lake, near Sudbury, Ontario** * Can J Fish Aquat Sci * 40(5) 621-626 * 1983-05.

Changes in Secchi transparency (depth) and thermal regimes accompanying experimental neutralization and subsequent re-acidification of Lohi Lake, near Sudbury, Ontario are described. Secchi depth was not correlated with chlorophyll concentrations, phytoplankton biomass or total phosphorus, but it was negatively correlated with pH. Secchi depth was positively correlated with thermocline depth, epilimnetic thickness, and hypolimnetic heating rates suggesting that acidification should result in deeper mixing zones and warmer hypolimnia in lakes. Several possible implications of changes in transparency and thermal regimes produced by acidification are presented.

5. GROUNDWATER - EAUX SOUTERRAINES

5.1 Quantity - reserves

063897
Water well records for Ontario, regional municipality of York (including Metropolitan Toronto) 1946-1979 * Water Resour Bull 2-30 * 492p * Water Resour Branch, Ont Minist Environ, Toronto, Ont * 1982.

This publication is one of a series which presents water-well information for the Province of Ontario. This bulletin contains water-well data for the Regional Municipality of York and Metropolitan Toronto for wells constructed during the period 1946 to 1979. Table 3 lists previous reports in which similar data have been published. The information in this bulletin has originated from water-well records completed by water-well drilling and boring contractors licensed in Ontario. The geographical area covered by this bulletin is shown on a map and a summary of the water-well statistics pertaining to the area is given.

064631
Lesser Slave Lake Regulation, Environmental Impact Assessment, Volume III, Land use impact studies (see chapter 4.5 for complete reference - voir chapitre 4.5 pour la reference complete)

F10220
BELANGER AJ * **L'exploitation des nappes aquiferes en milieu municipal** * Rev munic * 61(4) 31-32 * Publ Vero Ltee * 1983-04.

La Compagnie internationale des eaux Quebec Limitee se specialise depuis 60 ans au Canada dans le secteur de l'alimentation en eau potable, precisement dans le captage des nappes d'eau souterraine. Installee dans plusieurs provinces canadiennes dont au Quebec, la Compagnie internationale des eaux s'est donnee comme mission de deceler les nappes d'eau souterraines susceptibles de devenir source d'alimentation d'eau potable, precise M. Andre J. Belanger, directeur technique et gerant, lors d'une rencontre avec la redactrice de la Revue Municipale.

066204
BOUTETTE MJ * **Aquifer evaluation Amoco Carrot Creek** * 2v * 1981-07.

In order to locate a water source for a secondary recovery scheme, drilling and pumping tests were conducted at Amoco Carrot Creek WSW#2, LSD 3-14-52-12-W5. An aquifer was located. An aquifer evaluation, electric logs, and water chemistry analyses are included in the report. The appendix includes detailed pump test calculations, lithologic and electric logs, and water chemistries.

066205
CARLSON MR, TEPEL RR • **Aquifer evaluation for Bigoray 16-6 water source well, January 1980, 16-6-52-8-W5** • 33p • 1980-01.

A pumping test was conducted on a test well (Bigoray 16-6). The results indicated an adequate yield of good quality water. To aid in the aquifer evaluation an observation well (47 miles south of Bigoray 16-6) was used. Pumping test results, electric-logs, and water analyses are included in the appendix.

066681
CHRISTIANSEN EA, WHITAKER SH • **Geology and groundwater resources of the St. Walburg area (73F), Saskatchewan, 1973** • Map No 18 • 1 map • Sask Res Counc, Geol Div • (1983).

Glacial geology, bedrock geology, bedrock surface topography, and aquifers are illustrated in this map of the geology and groundwater resources of the St. Walburg area, Saskatchewan. Undifferentiated drift and disturbed bedrock are shown for glacial geology while bedrock geology is portrayed in the Judith River Formation, Lea Park Formation and Upper Colorado Group, Lower Colorado Group, and Mannville Group. Aquifers are described under groundwater chemistry, base of groundwater exploration, drift, and Ribstone Creek Tongue of the Judith River Formation. Thickness and soil composition are given for the various areas shown under bedrock geology, and glacial geology. A description of bedrock surface topography for the area is also supplied.

064256
CROWE AS, SCHWARTZ FW • **Assessment of reclamation potential and hydrologic impact of large-scale surface mining of coal in plains areas of Alberta: summary report of activities 1982-83, Appendix F, Computer analysis of the factors influencing groundwater flow in a system disturbed by strip mining, Report of progress 5 (February 15, 1983)** • 47p • (Alta Res Counc) • 1983-03.

The goal of this research is to examine how basic features of a hydrologic system and various strategies for reclamation will influence groundwater flow and salt transport at strip-mined sites. The program of study consists of several phases, which involve the development of various flow and transport models and detailed sensitivity analyses of the model parameters. The theoretical development of the problem and formulation of the groundwater flow model have been discussed in detail in the previous progress reports and hence, only a general overview of these theoretical aspects is presented here. All of the simulations we carry out are designed to provide a conceptual understanding of water level changes related to strip mining and the role of various parameters in controlling these changes. The first group of results presented in this report provides an analysis and synthesis of the response of large regional flow systems to mining. The second group of results provides a basis for examining the use of smaller-scale simulations to examine the process of spoil resaturation. At present, work is continuing on this smaller-scale system.

064240
DUSSEAULT M, SCOTT JD, ZINTER G, SODERBERG H • **Assessment of reclamation potential and hydrologic impact of large-scale surface mining of coal in plains areas of Alberta: summary report of activities 1982-83, Appendix P, Consolidation study on Forestburg overburden** • 24p • (Alta Res Counc) • 1983-02.

This document has been prepared as an interim report on the analysis of the Consolidation Test Program which was carried out in 1982 by the Forestburg Reclamation Study. Essentially, the report is a discussion of the test method, the results of the tests, and conclusions that have been made at this point. The test results concluded that consolidation occurs very rapidly under load or resaturation. This is unusual in the case of resaturation as water is still being absorbed long after the sample has completed settling. At high stress levels, further settlement will still occur when the sample is resaturated. Even at 460 kPa which corresponds to an overburden depth of approximately 23 m, settlement occurs upon resaturation. The type of resaturation fluid, groundwater or fresh water (distilled water) appears to make little difference on the amount of settlement which occurs and the rate of resaturation.

066218
EPEC CONSULT WEST LIMITED, 4211-95 ST, EDMONTON, ALTA, T6E 5R6 • **Village of Kitscoty, 1981 groundwater exploration and well installation program** • 89p • 1981-07.

Due to an expected population growth of Kitscoty, Alberta, an aquifer evaluation was conducted to determine an additional potable water supply. A production well was drilled (approximately 55.5 m) and completed, and pump tested for 69 hours, at a constant rate of 3.8 l/sec. A long term yield of 3.4 l/sec was calculated. It was expected that this yield, combined with that from the existing wells, should meet the town's average production

needs for the future. The chemical analysis showed the water to be hard and slightly high in iron, with a sulphate concentration slightly higher than acceptable limits. Well surveys, E-logs and pumping tests are included.

066231
EPEC CONSULT WEST LTD, 202-10712-100 ST, GRAND PRAIRIE, ALTA • **Groundwater investigations and well license application, Village of Wembley, 1980** • 38p • 1980.

The drilling and completion of a water well (approximately 140 feet deep) was done to supplement the existing two town well supplies. A 24 hour pumping test, at a constant rate of 32 igpm was conducted, and a safe yield of approximately 40 igpm was calculated. Details of the test are included in the report. Chemical analyses indicated high Total Dissolved Solids and iron content.

066340
EPEC CONSULT WEST LTD, 202-10712-100 ST, GRAND PRAIRIE, ALTA • **Groundwater investigations and well licence application, town of Beaverlodge, 1980** • 81p • 1980.

To supplement the existing supply and to meet future demands for the town of Grimshaw, an aquifer evaluation was conducted. Existing wells no. 4 and no. 5 were rehabilitated, and well no. 1 was replaced with a new production well no. 79-1. A 48 hour pumping test was conducted on the new well and a yield of 23.2 igpm was calculated. The water quality was found to be over the recommended maximum limits in total dissolved solids.

066228
EPEC CONSULT WEST LTD, 4211-95 ST, EDMONTON, ALTA, T6E 5R6 • **Groundwater exploration and well development, hamlet of Whitelaw, 1980** • 63p • 1981-02.

An aquifer evaluation was conducted in order to determine the feasibility of developing a groundwater supply in the immediate vicinity of Whitelaw. Four test holes were drilled; one was completed as a production well, one as an observation well, and two were abandoned. A 24 hour pumping test at a constant rate of 10.8 l/sec was conducted, and a long term yield of 1000 igpm was calculated. The water quality was hard, though suitable for human consumption. The only existing groundwater supply that could be affected by the pumping of the production well was the Whitelaw spring, which is used by local landowners. Interference was predicted to be minimal. The author recommended that production from the well be metered and that water samples be collected once per year for chemical analysis.

066240
EPEC CONSULT WEST LTD, 4211-95 ST, EDMONTON, ALTA, T6E 5R6 • **Preliminary groundwater evaluation, S1/2 Sec.30-22-3-W5M** • 21p • 1980-06.

A test hole was completed near the centre of the floodplain of Priddis Creek, to provide an indication of the saturated thickness, permeability and probable yield of sand and gravel aquifers underlying the area. A six hour pumping test, pumped at a constant rate of 60 igpm, was conducted. It was estimated that the gravel aquifer at this location could be pumped continuously over a six month period per year at a rate of approximately 60 igpm.

066213
EPEC CONSULT WEST LTD, 4211-95 ST, EDMONTON, ALTA, T6E 5R6 • **Town of Swan Hills groundwater exploration and well completion program 1980** • 117p • 1981-04.

Due to an increasing demand from the town of Swan Hills, it was decided that a surface water supply system be established from nearby Freeman Lake. In 1980, an aquifer evaluation was conducted to determine an interim water supply. Four water wells were used to establish aquifer capacity. An existing town well was deepened by 278 feet. Two new wells were completed plus one observation hole. Three separate pumping tests were conducted, and a safe yeild on each well was calculated. A combined capacity of 100 igpm is available from the wells. This amount of water is expected to meet the water demands of the town for two years. Chemical analyses showed overall good quality of water, although slightly high in pH. The report includes details of the test drilling, pumping tests, calculations and chemical analysis.

066308
EPEC CONSULT WEST LTD, 4211-95 ST, EDMONTON, ALTA, T6E 5R6 • **Town of Beaverlodge 1980-1981 groundwater program** • 43p • 1981-09.

The 1980-81 groundwater program describes an interim system that was designed to meet the water demands of Beaverlodge, Alberta, until the planned Beaverlodge River water system was completed in 1982. Groundwater was being extracted from six town wells, and this program guided the replacement of an old well (No. 2) with a new well (No. 7). The new well was completed and pump tested for 48 hours. Results indicated that the aquifer (approximately 200 feet) was capable of producing 240 cu m per day, approximately. All seven town wells will be maintained after the surface water system commences, and will be used as future stand-by water sources.

066207
EPEC CONSULT WEST LTD, 4211-95 ST, EDMONTON, ALTA, T6E 5R6 • **Groundwater investigations and well license application for the Bearspaw**

Ridge development S1/2 30-25-2-W5M and part of SW 28-25-2-W5M * 113p * 1980-09.

Due to the development of a proposed subdivision 6 km northwest of Calgary, groundwater investigations were carried out to locate an aquifer capable of supplying the 40 country residential lots of the proposed subdivision, plus an 18-hole golf course and club house. One production well (Well No. 2) and 3 observation wells were completed. A 102 hour pumping test of Well No. 2 was conducted and a long-term yield of 40 igpm was calculated. Data is included.

066206
EPEC CONSULT WEST LTD, 4211-95 ST, EDMONTON, ALTA, T6E 5R6 * **Groundwater investigations and well license application, town of Grimshaw-1980** * 118p * 1980-11.

Due to problems meeting the water demands of the town, during peak hours and seasons, plus problems with pipeline leakage, an aquifer evaluation was conducted in hopes of developing and replacing the present water supply system. A total of 6 testholes were drilled in two areas near Grimshaw. The first two, located on SE-29-83-23-W5M, were abandoned and the remaining 4 test holes were drilled in SE-28-83-24-W5M. Three were completed as observation wells, and one as a production well. A 48-hour pumping test was conducted on the production well. A yield in excess of 1,000 igpm was displayed. Though the water quality is hard, it falls within accepted limits.

066239
EPEC CONSULT WEST LTD, 4211-95 ST, EDMONTON, ALTA, T6E 5R6 * **Triple "L" mobile home park, water well no. 2 license application** * 38p * 1981-09.

An aquifer evaluation was conducted to establish whether or not there was a water supply suitable for the requirements of a mobile-home park. A 48 hour pumping test was conducted on a test well and a long term yield of 0.81 l/sec was calculated. High fluoride content in the water is a problem with many wells in the area. The author concludes that it is unlikely that a substantially lower concentration of fluoride could be obtained by replacing the well with another well in that aquifer. The production from Well No. 2 was not expected to have any detrimental effects on neighboring wells.

066216
EPEC CONSULT WEST LTD, 4211-95 ST, EDMONTON, ALTA, T6E 5R6 * **Town of Wembley groundwater exploration and well completion program 1980** * 45p * 1980-05.

Due to an expected increase in the town of Wembley's population, plus an expected one hundred per cent increase in commercial and industrial development, an aquifer evaluation was conducted to locate a water supply large enough to facilitate the increased water demand. Two existing town wells had a problem with gas, naturally occurring because of the characteristics of the Wapiti formation they were completed in. Two test holes were drilled; no. 1-80 (91.4 m deep) was abandoned, and no. 2-80 (67.1 m deep) was completed. It was pump tested for 48 hours, at a constant rate of 13 l/sec. A yield of 10.6 l/sec was calculated. The author recommends that this new well be used as the main water source as its efficiency alone is greater than the two existing town wells. Existing well data, details of the pumping test and chemical analyses are included in the appendix.

062459
FARVOLDEN RN * **Groundwater supplies for Waterloo region - the role of geology** * Geosci Can * 9(1) 68-70 * 1982-03.

The municipal water supply for the Kitchener-Waterloo-Cambridge region of Ontario is provided by wells in Quaternary gravels. There is justified concern that future needs cannot be provided for unless a new source is found. The favoured solution is a pipeline to Lake Erie at a very high cost ($150 million in the early '70s). Many informed geologists and engineers believe that additional groundwater supplies are available, and perhaps sufficient to meet the forecast demands. The key factor in a technical solution to the problem is better data on Quaternary stratigraphy. Funds have not been made available for basic stratigraphic studies using modern techniques and as a consequence hydrogeology cannot be used effectively in dealing with the problem. The inadequacy of geologic data is not limited to this region. Basic geologic mapping is lacking generally for assessment development and protection of our groundwater resources, and somehow we have to convince government officials and funding agencies that it will pay to correct this deficiency.

066538
FORD DC * **The physiography of the Castleguard Karst and Columbia Icefields area, Alberta, Canada** * Arct Alp Res * 15(4) 427-436 * 1983-11.

The Columbia Icefields are highland ice caps developed upon benchlands of massive platform carbonates in the Main Ranges, Rocky Mountains. Ice is discharged via major valley glaciers, including South Glacier, Castleguard Valley. The karst is developed along the southeast edge of the central icefields, extends beneath it, and drains to springs in Castleguard Valley. Altitudinal range of the karst is 1600 to 2600 m a.s.l. Mean annual temperature is estimated to range from 0 to -7C over this range. Treeline is at ca. 2100 m. All cirques and valleys were occupied by ice during the late Wisconsinan Glaciation. Modern glaciers are ca. 100 to 300 m in

thickness and are receding from well-marked Neoglacial moraines. Periglacial features are prominent on high carbonate surfaces that escaped neoglacial cover. The principal surface karst features are (1) subglacial precipitates found on newly exposed Neoglacial surfaces; (2) varieties of sinkholes seen on all exposed carbonates above 2000 m; (3) families of springs, most below 2000 m. Castleguard Cave is a major relict system. The first interpretations of the karst, using simple morphological evidences alone, supposed that the Cave was drained by glacial entrenchment during the Wisconsinan Glaciation. Two modern groundwater caves developed beneath it.

063681
FRANCIS RM * **Hydrogeological properties of a fractured porous aquifer, Winter River Basin, Prince Edward Island** * 154p * Waterloo, Ont * 1981.

A field and laboratory study has been carried out to determine the relative contributions of fracture and intergranular permeability to groundwater movement as a test site in the Permo-Pennsylvanian sandstone aquifer of Prince Edward Island. The field study included diamond coring one vertical and two inclined boreholes to 60 m depth and reconstructing core from the inclined boreholes to allow determination of fracture frequency and fracture geometry. Horizontal bedding plane fractures comprised 82% of all natural fractures and subvertical fractures were infrequent below about 35 metres. The number of both horizontal and subvertical fractures decreased with depth. Using a borehole periscope, apparent fracture apertures in the upper 20 metres of bedrock were estimated and the aperture distribution was found to be log-normal. Hydraulic conductivity profiles of the in situ rock mass in each borehole were obtained using constant head injection tests with a two metre packer spacing. An equation was derived to allow calculation of hydraulic conductivity from the results of injection tests conducted under turbulent flow conditions. Equivalent porous media conductivities showed a general decrease from 0.1 cm/s near the bedrock surface to 0.00001 cm/s at greater than 35 metres depth. The contribution of matrix hydraulic conductivity was determined by laboratory testing selected drill core samples using an Axial-Radial Permeameter. Hydraulic conductivities both parallel and perpendicular to the bedding planes generally ranged from 0.000001 cm/s to 0.00005 cm/s. The statistical method described by Snow(1970) was used to calculate the distribution of effective fracture apertures. The results show that the mean effective fracture aperture in the upper 35 m of the aquifer is about 1.1 x 0.01 cm and that the mean aperture decreases with depth. The observed decrease in both fracture frequency and effective fracture aperture are about equally responsible for the reduction in rock mass permeability with depth. Fluid flux and fluid velocity in the aquifer are controlled by the fracture system rather than the matrix in both the upper and lower aquifer zones.

066696
FULLER GA * **Land drainage in Saskatchewan** . IN: Third Biennial Plains Aquatic Research Conf, Proc, August 24 and 25, 1983, Montana State Univ, Bozeman, MT * SCOTT MD * Can Plains Proc 11 * 163-166 * Inst Nat Resour, Dep Earth Sci, Montana State Univ and Can Plains Res Cent, Univ Regina * 1983.

In 1981, after years of studying drainage on the plains, the Province of Saskatchewan passed the Drainage Control Act to regulate drainage. The Saskatchewan Drainage Control Act, which is administered by the Department of the Environment, accomplishes four main objectives; it enables the delegation of duties and responsibilities under the Drainage Control Act to local watershed commission, it enables the drainage of surface water to be controlled through a permit system, it provides a mechanism to resolve drainage and related flooding problems through a complaint system, and it provides a mechanism for appeals to an Appeal Board against decisions, orders or actions under the Drainage Control Act. In this way, the Act establishes procedures for requesting drainage permits, registering drainage complaints, establishing watershed commissions and appealing watershed commission drainage decisions. The Drainage Control Act will assist in maximizing the utilization of the water resources in the province.

066336
GILLMOR E * **Stettler aquifer study** * 73p * Alta Environ, Environ Prot Serv * 1980-06.

Due to a rapid rate of growth, the town of Stettler, Alberta requested that its licence for annual diversion of groundwater be increased. Before the licence could be granted, a study was done to determine whether the Stettler aquifer could support the annual diversion increase from 431,795 cu m per year (350 acre/ft/yr) to 740,220 cu m per year (600 acre/ft/yr). Hydrogeological data supplied by the town of Stettler was utilized for the study. A 48 hour pumping test, conducted in 1962, was conducted and a yield of 465 igpm was calculated. The author stated that it appeared that the Stettler aquifer was capable of supplying the 600 acre/ft/yr that had been requested.

066289
GROUNDWATER CONSULT GROUP, PO BOX 189, ST. ALBERTA, ALBERTA T8N 1N3 * **Licence application for water wells in SW1/4-Sec 12-Tp 49-Rge 20-W5M** * 148p * 1981-05.

Due to the construction of the Hanlon-Robb Gas Plant, Gulf Canada Resources Inc. requested an aquifer evaluation of two wells. The gas plant had a water demand of an estimated 75 igpm. Five testholes were drilled (WW3 - WW7, inclusive) to depths ranging from 140 to 300 feet. WW3, WW6 and WW7 were abandoned due to insufficient air lift yields. WW4 and WW5 provided air lift yields of 40 igpm and 174 igpm respectively. Two production wells were then drilled adjacent to these testholes, and were numbered WW6 and WW7. The water wells served as the main and secondary production wells, and the testholes were used as observation wells. Both production wells were pump tested; WW6 was tested for 96 hours at a constant rate of 120 igpm and WW7 was tested for 45.75 hours at a constant rate of 100 igpm. Both wells had calculated yields of 75 igpm. Minimal drawdown was measured in the observation wells. The author concluded that either well was more than adequate for a main water source. The second well could be used as a standby source. The water quality was found to be excellent, but would require softening if the water was to be used in the gas plant boilers.

066286
GROUNDWATER CONSULTANTS GROUP * **License application for water wells in the Village of Lavoy** * 120p * 1980-10.

Due to a failing groundwater supply well in the village of Lavoy, Alberta, an aquifer evaluation was conducted to support an application for two licenses; one for a new well that will be connected to the existing village well and another for two wells to be connected to the village water main. All wells are to be completed in an overburden channel which is limited in extent (1000 ft wide). The water supply from this aquifer is estimated to last 5 - 10 years, depending on the rate of growth of the village and amount of natural recharge to the aquifer. There are no other nearby sources of either surface or groundwater, and the author concludes that eventually water for the village will need to be extracted from the regional water line which has been proposed nearby Vegreville, Alberta.

066329
GROUNDWATER CONSULTANTS GROUP, PO BOX 189, ST. ALBERT, ALTA, T8N 1N3 * **Licence application for a water flood well LSD 14-Sec 4-Tp 39-Rge-W5M** * 69p * 1981-07.

In order to undertake a secondary oil recovery project in the Eckville area, an evaluation was conducted of the aquifer which was to be utilized as an injection source. The well would be required to produce 35,000 igpd (24.3 igpm). The potential groundwater sources were the various sandstone aquifers of the Paskapoo Formation. To avoid the possibility of interfering with existing water wells completed in the upper sandstone beds of this formation, a relatively deep water well was constructed in the lower sand members of the Paskapoo Formation. A testhole was drilled to a depth of 249 metres (817 feet) and cased and cemented to a depth of 198 metres (650 feet). The production well was pump tested on two occasions, with the first test being abandoned due to gas locking of the submersible pump. In an effort to avoid this problem with a submersible jack, a pump jack was installed in the well for the second pumping test. The test was conducted for 53 hours, with no mention of rate of pumping. Due to the pumping characteristics of a pumping jack, the flow from the well was erratic, as rates from between 5.8 and 14.6 igpm were calculated. During the pumping test, gas was observed to be escaping from the well, which also contributed to the wide and rapid fluctuations in the water level. The author concluded that the well was capable of a theoretical long term yield of 5 to 10 igpm, and that an additional water source could be developed at a depth of 300 to 350 feet. There was no hydraulic connection with the nearby shallower farm wells and no measurable impact on these wells was forseen.

066330
GROUNDWATER CONSULTANTS GROUP, 15619 - 112 AVE, EDMONTON, ALTA, T5M 2V8 * **Licence application, 1980 wells at Sylvan Lake (Computer printout data)** * 2v * 1980.

The reports consist of computer printout data submitted to support a licence application for groundwater diversion of two supply wells at Sylvan Lake, Alberta. The town council planned to pump the wells (80-1 and 80-2) alternatively at 250 igpm each and was considering construction of a third well to increase their water supply. Report 1980.1.4 is a summary of report 1980.1.3.

066326
GROUNDWATER CONSULTANTS GROUP, 15619 -112 AVE, EDMONTON, ALTA, T5M 2V8 * **Production wells 80-1 and 80-2 at Sylvan Lake** * 180p * 1980-08.

In order to locate additional groundwater sources, two production wells were successfully completed at Sylvan Lake, and were designated PW 80-1 and PW 80-2. Three observation wells were also drilled around each production well. Both production wells were pump tested for 72 hours at constant rates of 200 igpm, and observation well drawdown was recorded. PW 80-1 had a calculated yield of approximately 500 igpm and very little reserve capacity. It was recommended that both wells be pumped at 200 igpm initially, and that water levels be monitored carefully over the next few years. Pumping rate for well 80-1 could be increased if demand increased. The author suggests that

a third well could be completed to increase supply and states that a yield of 300 igpm on this well would be possible. PW 80-2 and the additional were operating in tandem would provide an effective way of minimising any drawdown interference as well as capture as much as possible of the groundwater discharge of the aquifer.

066331
GROUNDWATER CONSULTANTS LTD, 15619 - 112 AVE, EDMONTON, ALTA, T5M 2V8 * **Water well test drilling, Sylvan Lake, March-April 1980** * 77p * 1980-05.

Eight test holes were drilled as part of a program to evaluate specific sites for potential well yields. Three sites were chosen as most suitable for development of production wells which would have a combined capacity in the order of 500 gallons per minute. Five of the testholes were abandoned because their yields, ranging from 20-35 igpm were inadequate for the town's present requirement, though most could be developed, if needed, at a later date. Three test holes, No. 4(48.4m), No. 5(48.0m) and No. 7 (25.7m) were pump tested for four hours each, at constant rates of 50 igpm. Each test well showed that yields of 100-200 + igpm could be expected which, when combined, would easily meet the water requirements of the town. The author stated that a production well and 2 to 3 observation wells should be drilled at each of these sites and pumping tests carried out to determine the long term yield of the wells and to assess interference with surrounding domestic wells. The water quality was found to be good, although it was thought necessary to install iron removal equipment.

066324
GROUNDWATER CONSULTANTS LTD, 15619 - 112 AVE, EDMONTON, ALTA, T5M 2V8 * **Water well survey data and computer printout for Sylvan Lake production wells** * 123p * 1980.

This report contains supplementary data for a previous report on Production wells 80-1 and 80-2 at Sylvan Lake, Alberta. The report is divided into specific sections. The first section consists of field hoses from a well survey of domestic wells located around the two production wells. The second section is computer printout for calculated drawdowns from results of pumping tests on production wells. Data on the drawdown for the immediate vicinity of the two production wells is listed separately. The third section lists regional drawdown calculations.

066314
HALL PL * **Groundwater evaluation and pumping test SE1/4-29-49-23-W4M** * 40p * 1980-05.

An aquifer evaluation was conducted to locate a potable water supply for a proposed residential subdivision near the hamlet of Rollyview, Alberta. A testhole was drilled to a depth of 300 feet in the northwest corner of the property, but showed a low yield of 1 - 2 igpm, and was abandoned. A second testhole was drilled to a depth of approximately 100 feet, bottomed in a buried channel. A 12 hour pumping test was conducted, and a long term yield was calculated at 40 igpm. The author suggests that due to the narrowness of the channel, (its limited geographical extent), the yield was likely closer to 25-35 igpm. This yield would be sufficient to support 150 - 210 homes, but the author recommends that a central water distribution system would guarantee that all homes would be able to obtain adequate water supplies. A chemical analysis showed soft water with relatively high alkalinity. The water was potable, though it was a light amber color, and had an odor. Additional tests were being carried out to determine the causes and possible treatments.

066318
HARDY ASSOC (1978) LTD, CALGARY, ALTA * **LaSerena Southway Inn groundwater evaluation** * 18p * 1980-08.

An aquifer was evaluated to support an application for a license on a supply well for the La Serena Southway Inn, approximately one mile south of Red Deer. Two wells were drilled and completed; Well No. 1 to 235 feet and Well No. 2 to 230 feet. The wells were situated 170 feet apart. A 1 hour bail test was conducted on Well No. 1 at a constant rate of 20 igpm. The long term yield was calculated to be 53 - 77 igpm, depending on the analytical method applied. The theoretical Q sub 20 was calculated twice using a slight variation in the formula. A 24 hour pumping test was conducted on Well No. 2 at a constant rate of 30 igpm. The present operations of the inn require 14 igpm, and the author concludes that well No. 2 is sufficient to meet this need. A water analysis on Well No. 2 showed a soft, potable water.

066287
HARDY ASSOC (1978) LTD, 4810 - 93 STREET, EDMONTON, ALTA * **Monitoring of observation wells, drainage ditch, Shell Strathcona refinery** * 8p * 1981-02-13.

A proposed construction scheme for the Shell Scotford refinery included the use of a drainage ditch along the west property boundary for the purpose of lowering the water table during construction. Three domestic water wells were located west of the plant site in close proximity to the ditch. It was therefore necessary to monitor the influence of the ditch on the water levels in the surrounding area. This interim report contains a summary of the installation of the observation wells, and the water level observations. The final report was to be updated and issued on completion of the well

observations.

065355
HAYHOE HN, TOPP GC, BAILEY WG * **Measurement of soil water contents and frozen soil depth during a thaw using time-domain reflectometry** * Atmos-Ocean * 21(3) 299-311 * 1983-09.

The results of a field test of time-domain reflectometry (TDR) to measure apparent liquid soil water contents and to locate the unfrozen-frozen interface during thawing conditions is presented. The apparent liquid water content was observed in the fall and through a late winter thaw on two sand sites, one with a natural snow cover and the other with snow removed throughout the winter. Temperatures were monitored at intervals throughout the profile. the results indicate that TDR provides a method for monitoring apparent liquid water content and freeze-thaw processes.

066085
HENDRY MJ * **Hydraulic response of irrigating a slowly permeable tile-drained soil** . IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * v1 239-260 * Can Soc Civ Eng * (1981).

Twenty-fold increases in tile drain discharge were recorded from a shallow grid drainage site installed at the top of a thin, semi-confined gravel and sand layer during flood irrigation and heavy precipitation events. The gravel and sand layer is overlain and underlain by slowly permeable clay. Hydraulic conductivity data indicates that the effluent discharging during these events cannot be the same water as that applied to ground surface. Thus, other potential source areas had to be investigated. Electrical conductance, oxygen-18, deuterium and tritium data indicate that the drainage effluent comes from the gravel and sand layer and the lower part of the overlying clay. Mass balance equations are used to identify the volume of water from each of the above source areas on a discharge hydrograph for a precipitation period. The results indicate that the majority of the tile effluent comes from the gravel and sand layer (approximately 80%) and the remainder is derived from the lower part of the overlying clay. It is hypothesized, based on the data presented, that the increase discharge during flood irrigation and precipitation periods is the result of external loading.

065635
HJ PORTER AND ASSOC LTD, HALIFAX, NS * **Final report- Pugwash groundwater exploration program** * 78p * HJ Porter and Assoc Ltd, Situate 100, 5212 Sackville St, Halifax, NS B3J 1K6 * 1982-03.

During January and February, 1982 a groundwater exploration program was initiated at the Village of Pugwash, Cumberland County, Nova Scotia. Three wells were drilled to depths of 91.5m, 63m and 75.3m respectively and water samples were collected at the orifice discharge at various pumping rates and pumping times. Chemical analysis of the water indicated that the well water was of good chemical quality according to the Guidelines for Canadian Drinking Water. The supply capability of the Pictou Group formation in the Village is sufficient to meet all current demands and future demands of the order recommended in earlier investigations. The conditions of limited recharge area, the absence of steady state boundary conditions during the test period, strong formations anisotropy and risk of saline water contamination by encroachment of coastal waters or dissolved formation salts and the reliance on aquifer storage over prolonged drought periods define severe constraints which must be taken into account in the calculation of long term safe yield. These constraints require that the amount of drawdown in pumping wells be limited. A groundwater extraction rate of 3.0 litres per second is considered a safe yield given certain conditions.

066028
HJ PORTER ASSOC LTD * **Project LUM 1, groundwater capability: urbanizing areas of Lunenburg municipality** * vp * HJ Porter Assoc Ltd * 1982-02.

This report centered around the collection, analysis and interpretation of existing information concerning the groundwater capability in the urbanizing areas of the Municipality of Lunenburg. The climate, physiography, geology, bedrock geology, surficial geology and hydrogeology of the area are discussed. Both bedrock and surficial aquifers are examined. Water balance, quality and quantity are covered along with groundwater recharge. Aquifer dewatering in New Germany is also discussed in this report. This report also deals with water shortage problems, water treatment and the impact of municipal development. Recommendations for future work in the area are also presented.

065300
HJ PORTER ASSOC LTD, HALIFAX, NS * **Nictaux groundwater study** * vp * HJ Porter Assoc Ltd, Halifax, NS * 1980-03.

A groundwater study was completed in the Nictaux area of Annapolis County, Nova Scotia. All existing hydrologic data on the area was reviewed and analyzed. Further data was collected which might affect the groundwater supply. Potential sources of pollution such as garbage dumps were located. Testing for water quality was carried out at several sites. Resident interviews were conducted on a random basis to provide further information. The existing data and this newly-acquired data

was then analyzed and correlated. Test drilling was done in two distinct aquifers to determine the optimum well locations. After an evaluation of all data; plans for both a groundwater resource management and a continuing monitoring program were suggested.

064245
HOWARD A * **Assessment of reclamation potential and hydrologic impact of large-scale surface mining of coal in plains areas of Alberta: summary report of activities 1982-83, Appendix U, Soil moisture movement studies on reclaimed and unmined land, Battle River area, Alberta - preliminary results** * vp * (Alta Res Counc) * 1983-02.

This report presents an overview of the Plains Hydrology and Reclamation Project and lists the rationale for the project and its objectives. Details are presented of studies relating to the assessment and evaluation of the infiltration, groundwater recharge, and groundwater-surface water interactions within cast overburden. Included are data and conclusions obtained from studies of water movement in the unsaturated zone and infiltration studies conducted from 1979-1981. The selection of sites for construction of infiltration plots is described as well as the methods used in the study. Results are presented for each site, the conclusions of the study are listed, and necessary follow-up studies are described.

064246
HOWARD A * **Assessment of reclamation potential and hydrologic impact of large-scale surface mining of coal in plains areas of Alberta: summary report of activities 1982-83, Appendix V, Soil water movement studies, Battle River Site, Report of progress, March 1983** * vp * (Alta Res Counc) * 1983-03.

This report presents details of soil moisture movement studies conducted in the Battle River area of Alberta. Methods used in flood testing and for the natural soil moisture monitoring are described briefly. Calibration equations for the Troxler neutron probe are presented and data are given on snow accumulation in the area. Curves representing moisture content changes as a result of the flood testing are presented. Drainage rates from the top metre of flood test sites at Battle River are presented and show that drainage rates drop rapidly following the stoppage of infiltration. Natural soil moisture changes in the top metre of Battle River sites are presented and data for the soil moisture content from the monitoring program for 1982 are given. The data show that wettest soil moisture conditions exist in the spring and early summer, especially in the 2 to 4 metre depths. The flood testing activities have been useful in providing a descriptive analysis of subsurface moisture redistribution in both the mined and unmined settings. The soil moisture content data and estimates of drainage from the natural soil moisture movement sites show that early spring is the period where recharge is most likely to occur. Soil moisture contents are highest and evapotranspiration is low and both of these conditions will provide a greater probability of recharge.

066025
HUDSON RF, CARTER CD * **Preliminary water resources study Southwestern Nova Scotia** (see chapter 2 for complete reference - voir chapitre 2 pour la reference complete)

066332
HYDROGEOLOGICAL CONSULTANTS LTD. * **British Columbia forest products, Grand Cache - sawmill complex, 1980 groundwater program, 57-6-W6** * 109p * 1981-01.

Due to a need to develop a groundwater supply of approximately 20 to 50 igpm for the proposed Grande Cache sawmill complex, exploratory drilling and aquifer tests were conducted. Part of the water supply was to be used for domestic needs with the remainder to be used in the sawmill, and also to replenish the firewater ponds. Six test holes were drilled to depths of 7.9 to 158.5 metres. A total of six recovery tests were carried out on 2 holes and five aquifer tests were conducted with four of the six holes. A short aquifer test was also conducted on the construction camp well located near the north boundary of the proposed development site. Specific pumping rates of the wells were not discussed, although the author did conclude that no aquifers were found which would provide the quantity (20 to 50 igpm) needed.

066276
HYDROGEOLOGICAL CONSULTANTS LTD, EDMONTON, ALTA * **Town of Ponoka, 1979 groundwater program** * 77p * 1980-04.

In hopes of finding an additional water source to augment the existing water supply, which relied entirely on wells, an aquifer evaluation was done in the town of Ponoka, Alberta. The volume of groundwater required on a long term basis was 600,000 igpd. Two water test holes were drilled and completed, and designated WTH No. 1-79 and WTH No. 2-79. WTH No. 1-79 (30.2 metres) was pump tested for 105 hours at a constant rate of 455 igpm. WTH No. 2-79 (61 metres) was pump tested for two hours at a constant rate of 201 igpm. The author concluded that if the wells were pumped individually, the estimated long term yield for both would be 200 igpm. However, if both water test holes were pumped simultaneously, the effects of interference would reduce the estimated long term yield of WTH No.'s 1 and 2 to 100 and 140 igpm, respectively. Since the combined well yields would supply only 58% of the required 600,000 igpd, it was recommended

that a detailed groundwater monitoring program be designed and that an additional groundwater evaluation be conducted.

066342
HYDROGEOLOGICAL CONSULTANTS LTD, EDMONTON, ALTA * **Town of Canmore, 1979/80 groundwater program** * 56p * 1980-11.

Due to the need for an alternate groundwater supply system in the town of Canmore, an aquifer evaluation was conducted. The town derived its existing supply entirely from the Spray Lake Reservoir. The volume of water required on a long term basis was 720,000 igpd. Two water test holes were drilled: No. 1-79 to 24.7 metres, and No. 2-79, 15.2 metres north of No. 1079, was drilled to 18.9 meters. A 72 hour pumping test was conducted on WTH No. 1-79, at a constant rate of 696 igpm. The estimated long term yield was calculated to be in excess of 700 igpm. The author recommended that WTH No. 1-79 be redesignated as water well No. 1, and that WTH NO. 2-79 be redesignated as Observation Well No. 1. The author concluded that pumping WTH No. 1-79 for long periods of time was not expected to have an adverse effect on the water levels in domestic wells in the vicinity. The chemical quality of WTH No. 1-79 would be suitable for the intended purposes without treatment.

066280
HYDROGEOLOGICAL CONSULTANTS LTD, EDMONTON, ALTA * **Village of Elnora 1979 groundwater program, water well no. 4** * 40p * 1980-03.

The village of Elnora, Alberta, was utilizing three existing wells, of which two were completed with two inch surface casing. A new well was needed for standby purposes, as it was thought that the two inch wells may be unreliable in the future. The volume of water needed by the village on a regular basis was 50,000 igpd. The new well (WW No. 4) was drilled to 91.4 metres, and a 24 hour pumping test, at a constant rate of 40 igpm was conducted. The projected long term yield, using approximately two thirds of the saturated thickness of the aquifer for available drawdone, was recorded as calculated to be a "few hundred igpm". Water well No. 3, located 5.7 metres northwest of No. 4, was used as an observation well. The author concluded that WW No. 4 would provide an adequate water supply not only for now, but for the forseeable future. Because the anticipated use was less than 20% of the projected long term yield, the diversion from the well will have only a limited interference with the existing non-municipal water wells in the area. The water quality was not within the recommended maximum limit for potable water, mainly because of the high TDS and sulphate content.

066288
HYDROGEOLOGICAL CONSULTANTS LTD, EDMONTON, ALTA * **1980 groundwater program, NE-1-40-16-W4** * 54p * 1980-07.

An aquifer evaluation was conducted in order to find and develop a groundwater supply to be used for domestic needs at the proposed Paintearth Mine Site. The minimum volume of water required was estimated to be 30,000 igpd. Two water test holes were drilled, both to a depth of 85.3 m, and designated WTH No. 1-80, and WTH No. 2-80. Two aquifer test phases were done in the first, WTH No. 1-80 was pump tested for 2 hours at a constant rate of 4.9 igpm, and WTH No. 2-80 was pump tested for 2 hours at a constant rate of 4.7 igpm. In the second phase, WTH No. 1-80 was tested for 1000 minutes at a constant rate of 4.0 igpm. The results of the testing showed that, if pumped on an individual basis, the estimated long term yields of WTH No.'s 1-80 and WTH No.'s 2-80 would be 6.0 and 4.0 igpm, respectively. If the water test holes were pumped simultaneously, the yields would be reduced to 5.0 igpm for No. 1-80, and 3.0 igpm for No. 2-80. The author concluded that long term pumping of these test holes would not likely cause interference in near-by, shallow wells.

066267
HYDROGEOLOGICAL CONSULTANTS LTD, EDMONTON, ALTA * **Thiessen Farms Ltd 1978 water well** * 48p * 1980-04.

An aquifer evaluation was done to find and develop a water source capable of supplying an estimated 40,000 igpd to a feed lot located on the Thiessen Farms in Strathmore, Alberta. Five water test holes were drilled and designated No.'s 1-78, 2-78, 3-78, 4-78 and 5-78. WTH No. 3-78 was abandoned when difficulties in completing the test hole were encountered. Aquifer tests were conducted on WTH No.'s 2-78, 4-78 and 5-78. In phase one of the aquifer test, a 2 hour pumping test, at a constant rate of 36.6 igpm, was conducted on WTH No. 4-78, No. 4-78 was tested again in the second phase. A 168 hour pumping test, at a constant rate of 50 igpm, was conducted. Two-hour pumping tests were conducted on both WTH No. 2-78 and 5-78. Though specific yields were not given, the author concluded that WTH No. 4-78 was expected to be adequate for the long term needs of the proposed feed lot.

066809
INTERPROVINCIAL ENGINEERING LTD * **Groundwater capability: Chester Village, Gold River, Western Shore in Chester Municipality** * 86p * Interprovincial Engineering Ltd, Halifax, NS * 1982-05.

This report examines the groundwater supply capability of the surficial and bedrock geological units which underlie the communities of Chester Village, Gold River, and Western Shore, Nova Scotia in relation to

present and future demands. Local and regional assessments of the following criteria were carried out: geography; geology - bedrock and surficial; hydrology including precipitation, runoff, evapotranspiration and groundwater recharge or infiltration; theoretical groundwater budgets; hydrogeology; groundwater supply considerations; groundwater quality, and; groundwater management considerations. The theoretical amount of groundwater available in the Chester Village watershed is 1,642 igpm and the total estimated present day water useage is 121 igpm or 10% of available supply. In comparison, the Gold River-Western Shore watershed is 2,434 igpm and the water useage is 63 igpm or 3% of available supply. The general quality of groundwaters in the study areas is good with local exceptions due to poor well construction, salt water intrusion and salt contamination from road deicing activities. Future consideration of a central water supply for residents, large scale industrial or institutional users should be assessed individually as to their site specific and overall use of this resource.

063526
IRWIN RW, WHITELEY HR * **Effects of land drainage on stream flow** * Can Water Resour J * 8(2) 88-103 * Can Water Resour Assoc, PO Box 250, Kingston, Ont K7L 4V8 * 1983.

We reviewed papers dealing with the effects of land drainage on streamflow, conclusions on effects are difficult to establish because response varies with different types of drainage work and differing physiographic and climate situations. Coincident changes in land use, and the high variability of inputs, add complications. For the range of events giving rise to most floods a combination of subsurface drainage and outlet enlargement has little effect on flood peaks. Flood peaks are reduced when high-water table areas are drained. Connection of swamps or enclosed areas to rivers by large arterial drains increases flood peaks.

063939
KAZANTZIDES E * **Addendum to the Meeting Creek investigation (File No. 1330)** * 17p * Alta Environ, Environ Prot Serv, Earth Sci Div * 1981-01.

A groundwater investigation was conducted as part of an Alberta Environment (Municipal Engineering and Groundwater branches) program of assistance to small communities having difficulty in obtaining a water supply. As part of this program, the Groundwater Branch, Earth Sciences Division of Alberta Environment, conducted a test drilling program for the Hamlet of Meeting Creek during September, 1979. Test holes No. 1 (SE 8-43-19-W4) and No. 2 (SE 5-43-19-W4) were drilled to a depth of 76 m (251 ft). A twenty-year safe yield of 4.5 L/min (1 igpm) was determined from a five-hour pumping test conducted on test hole No. 2. The quality of the bedrock water is poor since it exceeds the Canadian Drinking Water Standards for total dissolved solids, sodium, alkalinity, sulphates and iron. If the establishment of a groundwater supply is to be pursued for this hamlet, it is recommended that areas further than 2 km (1.2 miles) from the hamlet should be investigated.

063529
KOPPULA SD * **Porewater pressures due to overburden removal** * J Geotech Eng * 109(8) 1099-1110 * 1983-08.

A mathematical model describing the behavior of a fully saturated sediment subjected to a uniformly eroding load is developed on the basis of Terzaghi's classical consolidation theory. The model is used to analyze simultaneous generation and dissipation of deficient pore water pressures. A moving boundary erosion/swelling problem results from this formulation. Analytical solutions are obtained for several cases of practical interest. The computed results are presented in dimensionless quantities. It has been found that the deficient pore water pressure normalized with respect to the (soil) weight removed at any instant is a function of: (1) The ratio of the depth to the thickness of soil removed up to that instant; and (2) the ratio of the rate of soil removal to the swelling coefficient of the soil.

066695
LORBERG EF * **Groundwater component of the South Saskatchewan River basin in Alberta** . IN: Third Biennial Plains Aquatic Research Conf, Proc, August 24 and 25, 1983, Montana State Univ, Bozeman, MT * SCOTT MD * Can Plains Proc 11 * 61-73 * Inst Nat Resour, Dep Earth Sci, Montana State Univ and Can Plains Res Cent, Univ Regina * 1983.

The Earth Sciences Division of Alberta Environment calculated the natural throughflow of groundwater in the South Saskatchewan River Basin and identified the recharge areas. Comments on the effects of irrigation on groundwater flow are given and a brief description of groundwater chemistry and use is presented.

065222
MAATHUIS H, DYCK JH * **Assessment of summer precipitation enhancement on groundwater in Saskatchewan Crop District areas 1A, 3B-S, and 7A** * SRC Tech Rep No 121 * 61p * Sask Res Counc, Saskatoon, Sask * 1982-01.

The recession curves of median monthly hydrographs from shallow observation wells during the period from summer through fall suggest that there is virtually no recharge influence from summer precipitation. However, individual records indicate that recharge from

summer precipitation may occur occasionally. These recharge events appear to be related to intense storms and favourable soil conditions. Both hydrograph records and detailed studies indicate that occurrence of recharge from summer storms is infrequent and isolated in terms of time and space. Summer precipitation in Crop Districts 1A, 3B-S, and 7A has averaged about 200 to 300 mm per growing season based on a period of record from 1941 to 1970. An increase in total amount of summer precipitation (varying from 20 to 90 mm) as result of precipitation augmentation will likely have no major effect on groundwater recharge. Increase in precipitation from convective storms may increase the propensity for recharge. Recharge from this type of rainfall enhancement, however, will also be isolated in terms of time and space. Enhancement of rainfall from frontal systems is likely to have no effect on the water table level, except possibly in discharge areas. Much more investigation is required before the impact of summer precipitation enhancemnent on groundwater levels can be assessed in more detail. Water well drilling and well construction practice in Crop Districts 1A, 3B-S, and 7A appears to be characterized by a relatively large proportion of "shallow" wells (i.e. less than 30 m deep). Crop Districts 1A and 3B-S have a relatively larger proportion of shallow wells than does 7A. Water levels in shallow wells are more likely to be affected by summer precipitation than water levels in deep wells, thus a larger proportion of wells could be affected by water level fluctuations in districts 1A and 3B-S than in 7A. The relative effect of factors which influence water production from "as built" wells depends on many parameters including hydrogeological and well construction. Hydrogeological knowledge of an area and application of sound engineering and technical practice are a prerequisite to taking advantage of any slight positive effects which precipitation enhancement may have on groundwater levels.

062040
MACKAY JR * **Downward water movement into frozen ground, western arctic coast, Canada** * Can J Earth Sci * 20(1) 120-134 * 1983-01.

Field studies carried out mainly since 1975 in permafrost areas of Alaska, Canada, China, and the Soviet Union have been combined with the results of laboratory investigations to show that in summer water can move from the thawing active layer into the subjacent frozen active layer and under certain conditions even into the top of permafrost. Direct field evidence discussed includes: data from drilling and neutron probe logging, which show a summer increase in the ice content of already frozen ground; summer heave of heavemeters, with heave occurring in the frozen active layer; and increase in the ice content of the subjacent frozen ground in both permafrost and non-permafrost areas, caused by snowmelt infiltration. Indirect field and laboratory evidence is also added to support the direct lines of evidence. The conditions that favor the downward migration of water from thawed to frozen ground are examined in terms of thermally induced hydraulic gradients, hydraulic conductivity, content of unfrozen pore water, temperature gradients, ice content, and gravity. Some geocryologic implications of the summer growth of ice in frozen ground, including the effects on water balance calculations and the origin of patterned ground, are briefly mentioned.

065106
MLM GROUND-WATER ENG * **Ground-water resources, Cold Lake - Beaver River basin** * 52p * MLM Ground-Water Eng * 1982-03.

This report deals with the groundwater resources part of the water supply component of a multi-component study formulated by Alberta Environment. It reviews all available groundwater data, prepares an overview of ground water as water supply source in the study area, reviews the various water withdrawal demand scenarios prepared for time horizons 1985, 2000 and 2015, determines the existing and potential significance of groundwater as a water-supply source on a local and regional scale, and devises a procedure and account for ground water/surface water interaction where data are inadequate and the interaction is critical to the surface water supply balance. Aquifer geology, hydrogeology and groundwater supply potential and ground water - surface water interactions, are detailed. Work to be undertaken is recommended so that problems identified in determining the regional flow system are solved and a good understanding of the flow system to determine the study's groundwater resources, is obtained. The use of a three-dimensional model for quantifying and allocating groundwater resources, is described.

066724
MONTREAL ENG CO LTD * **Final report, Southwestern Nova Scotia water supply requirements and development feasibility, Phase II Southwestern Nova Scotia Water Resources Evaluation Project** (see chapter 4.11 for complete reference - voir chapitre 4.11 pour la reference complete)

062030
PAUL CL, DE VRIES J * **Soil trafficability in spring, 1. Simulation of the drainage process** * Can J Soil Sci * 63(1) 15-26 * 1983-02.

A mathematical-physical model developed in the Netherlands for the simulation on nonsteady flow of water in subsurface-drained soils was tested by compairing its output with data collected in spring from two farmers' fields in the Lower Fraser Valley of British

Columbia. The ultimate objective of the tests was the prediction of soil strength and trafficability. The model was found to be useful for predicting depth to the water table and, to a lesser extent, soil water matric potential in the top 15 cm in fields drained by drains spaced at 30.5 m and 15.2 m. However, there were problems in evaluating input data. One problem was that of obtaining the drainage intensity, which was found to have a great effect on model output. A solution of the modified Glover-Dumm transient-state drainage equation provided a means of obtaining the drainage intensity directly from measured water table recession. A second problem was related to the use in the model of soil water flow parameters obtained from the water flow characteristic measured on undisturbed columns in the laboratory.

062029
PAUL CL, DE VRIES J * **Soil trafficability in spring, 2. Prediction and the effect of subsurface drainage** * Can J Soil Sci * 63(1) 27-35 * 1983-02.

Effects of subsurface drainage on trafficability of farmland were assessed over a 2-yr period. When compared with undrained land, drainage by drains spaced at 30.5 m resulted in earlier trafficability by 2-4 wk in a silty clay loam and by up to 5 wk in a muck. Halving the spacing did not increase benefits. Drainage intensity exerted its greatest influence on trafficability when the intensity was low, that is, at large drain spacings. Prediction of trafficability by two procedures revealed close agreement with one another and compared extremely well with dates on which measured water table depth and soil water tension were considered by farmers to be adequate for trafficability.

066674
PERSRAM A * **Pumping test, Standoff, Alberta** * 32p * Alberta Environ, Environ Prot Serv, Earth Sci Div, Groundwater Branch * 1981-10.

In response to a request by the Department of Indian Affairs, the Earth Sciences Division of Alberta Environment conducted a hydrogeological study at Standoff, Alberta in June, 1980 (Persram, 1980). The objective of the study was to determine if a gravel aquifer at the townsite could meet the projected water requirement of 21.56 L/S (285 igpm) by the year 1988 (Cambrian Engineering Group Ltd., 1978). The preliminary results of an aquifer test, conducted at a discharge rate of 6.18 L/S (90 igpm), indicated that the aquifer is capable of yielding the required quantity of 21.56 L/S (285 igpm). However, the discharge rate for the pumping test was too low for a precise determination of the aquifer capability. Subsequently, Associated Engineering Services Ltd., the consultant for the Blood tribe, recommended that the existing production well should be re-tested at a discharge rate close to the projected water requirement of the townsite. Following the recommendation, a 4 inch submersible pump with a rated capacity of 15.13 L/S (200 igpm) at a total dynamic head of 16 bars (231 psi) was installed in the existing production well. The pump intake was set at 20.06 m (66 ft) below ground level. In addition to the production well, six piezometers were also installed to measure drawdown and recovery during the pumping test (see Figure 1 for piezometers location). This report present the results of the pumping test and some recommendations with regard to the design of additional production wells in order to meet the projected water requirements.

063920
PERSRAM AS * **Groundwater investigation, Frank Slide, Leitch Colleries, Preliminary report** * 6p * Alta Environ, Environ Prot Serv, Earth Sci Div, Groundwater Branch * 1981-10.

A report is given of a preliminary groundwater investigation in the Frank Slide and Leitch Colleries areas of Alberta to determine the feasibility of using groundwater for the Tourist Information Buildings to be erected. A description is given of the areas including the general geology and the hydrogeology. Due to the lack of pertinent hydrogeological data, test drilling was recommended for both areas. Details of the test drilling are presented and estimates are given for costs of completing a well.

062881
PICKENS JF, GRISAK GE * **Modeling of scale-dependent dispersion in hydrogeologic systems** * Water Resour Res * 17(6) 1701-1711 * 1981-12.

An approach for handling scale-dependent dispersion using a finite element (linear triangular) solute transport model was developed. Dispersivity is allowed to vary temporally as a function of the mean travel distance of the solute from an input source. Various scale-dependent dispersivity relationships were presented including types which approach continuously to a maximum or asymptotic value. The finite element model results were verified for a one-dimensional case by comparison of the theoretical variances of the solute distribution for a given dispersivity-travel distance function with the variances calculated from the finite element model concentration distributions. The model was applied successfully to the results of several tracer tests reported in the literature that have exhibited a scale effect. For systems that exhibit a constant (asymptotic) dispersivity at large times or mean travel distances, the importance of scale-dependent dispersion at early times or short travel distances was shown to be minimal in long-term predictions of solute transport.

061848
ROWE JS, ABOUGUENDIA ZM * **The Lake Athabasca sand dunes of Saskatchewan: a unique area** * Musk-ox * (30) 1-22 * 1982.

A study of the terrain in a 1200 sq km block bordering the south shore of Lake Athabasca in Saskatchewan was carried out by a multidisciplinary team during the summers of 1979 and 1980. Geologists, hydrologists, pedologists, biologists, ecologists, and archaeologists joined forces to investigate the unique boreal environment characterized by active dune fields and open gravel plains. The area constitutes an aquifer discharging into the lake. Surface stability varies with depth of overburden to the underlying Athabasca Sandstone and with depth to water table, so that the most extensive sand sheets and the largest dunes coincide with the deepest deltaic and lacustrine deposits. Ten very rare plants, eight of which are Saskatchewan's only endemics, are a distinctive part of the flora. This remarkable area should be protected, for it is sensitive to hydrologic changes such as those that may come with dams and diversions in the Mackenzie River basin.

062450
RUSHTON KR, HOWARD KWF * **The unreliability of open observation boreholes in unconfined aquifer pumping tests** * Ground Water * 20(5) 546-550 * 1982.

Initial attempts to estimate unconfined aquifer parameters from a pumping test using an open observation borehole proved to be unsuccessful. However, when separate piezometers were installed along a vertical section, significant differences in ground-water head were noted. These differences suggest that rather than providing an average ground-water head, the open borehole provides a means of flow between the different elevations and therefore produces misleading results. The results for the separate piezometers are analysed using a numerical model, and reasonable values of the aquifer parameters are deduced.

061876
SCHMIDTKE KD, MCBEAN EA, SYKES JF * **Stochastic estimation of states in unconfined aquifers subject to artificial recharge** * Water Resour Res * 18(5) 1519-1530 * 1982-10.

An extended Kalman filter model for characterizing minimum variance estimates of the piezometric heads and coefficients defining an unconfined aquifer subject to artificial recharge is developed. The system evolution model employs Hantush's (1967) model. Sensitivity analyses are used to test the estimation capability of the technique. The ability of the extended Kalman filter to use all available information from both the system model and measurements of the state to provide approximate minimum variance estimates of the state and confidence limits is shown. The extended Kalman filter version of Hantush's model is applied to a record data length of one year obtained at the study area located in Norwood, Ontario.

065182
SCHNEIDER A * **Groundwater forecast for 1979-1981** * SRC Tech Rep no 107 * 9p * Sask Res Counc, Saskatoon, Sask * 1980-05.

As of spring 1979, the annual precipitation fell below normal in most parts of Saskatchwan. For the purpose of this forecast, it is assumed that this trend will continue during the coming 12-18 months. Evaluation of the groundwater levels monitored by the Research Council's 46 observation well in Southern Saskatchewan indicates that these water levels can be expected to drop below the minimum levels recorded during the spring of 1979. On the other hand, water levels monitored in the extreme southeast of the Province and in the Hudson Bay area do not follow the downward trend; in these areas, the groundwaters tend to maintain their present level or may even rise to a modest degree. Water levels in all deep observation wells presently tend to decline in the southern part of Saskatchewan. Again, this trend is expected to continue well into the year 1981.

064254
SCHWARTZ FW, CROWE AS, MORAN SR * **Assessment of reclamation potential and hydrologic impact of large-scale surface mining of coal in plains areas of Alberta: summary report of activities 1982-83, Appendix D, Model studies on the impact of mining on groundwater flow systems** * 18p * (Alta Res Counc) * 1983-03.

In this study, a groundwater flow model suitable for simulating hydrogeological changes caused by strip mining is described, and a series of applications designed to provide an understanding of the response of a groundwater system following reclamation is presented. More specifically, the study examines the process of mine-spoil resaturation as influenced by recharge rates and hydraulic conductivity distributions. A transient flow model has been developed, which calculates both the distribution of head within a flow domain and the position of the water table. The model operates with a one-step iteration procedure, where the position of the water table is accurately determined after successive iterations. The model enables seepage faces to form as the water table intersects the ground surface. In order to assure that applications are realistic, the model cross sections are based on conditions commonly observed in central Alberta. The results show that both local and regional effects influence spoil resaturation. The short-time, local effect involves the elimination of the potential low caused by earlier groundwater discharge into the mine-

pit. The regional effect represents the long-term readjustment of the flow system as a major discharge area in the system is removed. In addition, results show how changing hydraulic conductivity distributions can influence the pattern of spoil resaturation and flow system readjustment.

066542
SMART CC * **The hydrology of the Castleguard karst, Columbia Icefields, Alberta, Canada** * Arct Alp Res * 15(4) 471-486 * 1983-11.

The Castleguard area is a classical alpine karst, characterized by high relative relief and partly overlain by glacier ice. Access to the subglacial aquifer is possible via a relict cave. Drainage of the glacier bed occurs at both the conduit and diffuse flow scales. The contemporary hydrology is dominated by supraglacial meltwaters, which have been traced into the groundwater system. More than 100 springs in the Castleguard Valley constitute a hierarchy based on size and relative elevation. Status within the hierarchy is demonstrated by behavior as "underflow" or "overflow" springs. Floods emerging from springs perched 300 m above the valley floor are an overflow probably derived from the Saskatchewan Glacier. Quantitative dye tracing has revealed complex spring behavior, largely in response to changes in the spatial distribution of recharge. The aquifer appears to be mature, with a well-developed conduit network. The numerous springs are a product of disruption by glaciation; disturbance appears to be the major effect of glaciers upon this karst aquifer. Ice may be drained karstically where sufficient pressure gradients exist; decreased ice velocities and erosion rates are possible effects of underlying karst upon glaciers.

066537
TOTH J, MILLAR RF * **Possible effects of erosional changes of the topographic relief on pore pressures at depth** * Water Resour Res * 19(6) 1585-1597 * 1983-12.

Formation fluid pressures are said to be anomalous or abnormal if they differ from hydrostatic for the depth considered. Explanations of the origin and maintenance of anomalies seldom include the possibility of delayed adjustment of subsurface pore pressures to erosional modifications of the topographic relief. Yet the present paper shows that it is entirely possible for subaerial erosion to generate pore pressure changes at great depths by cross-formational energy transfer in realistic field conditions. Conversely, pressures may survive changes in the topography and be in a transient state for hundreds to millions of years, thus appearing anomalous at the time of observation. According to calculations for the Red Earth region in Alberta, Canada, present pore pressures in the Devonian immediately above the Precambrian basement at a depth of approximately 1400 meters may have been induced originally by erosionally shaped topography during Pliocene times 12 to 1 m.y. B.P. but be adjusting now to new boundary conditions created by the erosional exposure of the sub-Cretaceous unconformity. A 12% adjustment may already have taken place during the last 300 thousand years, leaving nearly 90% of Pliocene age pressures to survive to date as slowly decaying transient pressure relicts of the geologic past. In view of the possible erosional effects on pore pressures demonstrated in this paper, the question of anachronous formation pressures may deserve consideration in problems related to deep basin hydrology, including regional groundwater resource development, migration and accumulation of hydrocarbons radioactive waste isolation, dating of various geologic events, and so on.

064252
TRUDELL MR * **Assessment of reclamation potential and hydrologic impact of large-scale surface mining of coal in plains areas of Alberta: summary report of activities 1982-83, Appendix B, Hydrogeology of mine spoil, Battle River Site, March 1983 update** * 16p * (Alta Res Counc) * 1983-03.

The instrumentation at two coal mines in the Battle River area of Alberta is described. At Diplomat Mine, located on the north side of Battle River, 46 piezometers have been installed at 16 sites in reclaimed spoil. The water table in the instrumented areas has been re-established at depths from 0 to 7.7 m below ground surface. Groundwater flow and trends in vertical hydraulic gradients in the area are described. Preliminary analyses of water level records indicate that groundwater levels in spoil at Diplomat Mine have stabilized, subject to seasonal variations through the year. The hydraulic conductivity of spoil at Diplomat Mine has been determined by single-well response testing of piezometers and by permeameter testing of shelby tube core samples. At Vest Mine, located south of the Battle River, 27 piezometers have been installed at 8 sites. The water table and ponds in the area are described as well as groundwater flow and trends in vertical hydraulic gradients. The log mean hydraulic conductivity of Vesta spoil is given, based on piezometers and permeameter tests.

064248
TRUDELL MR * **Assessment of reclamation potential and hydrologic impact of large-scale surface mining of coal in plains areas of Alberta: summary report of activities 1982-83, Appendix W, Groundwater recharge at the Battle River Site** * 5p * (Alta Res Counc) * 1983-02.

Groundwater recharge in mined and unmined settings at the Battle River site has been

evaluated by two methods. The first is based on an analysis of hydrographs from water-table wells and shallow piezometers, and the second is based on the calculation of leakage from ponds and sloughs.

064738
TURNER ME • **Ground water probability, County of Simcoe (northern portion)** • Water Resour map 3126 • vp • Ont Minist Environ, Water Resour Branch, Toronto, Ont • 1982.

The inorganic chemical quality of ground water at locations in the study area can be estimated by inspecting the analyses of nearby ground water samples. Samples were taken from selected overburden and bedrock wells and indicate quality of ground water in the common water-bearing zones in different parts of the study area. Of the wells sampled in the northern portion of the County of Simcoe, 2% have salty water, 19% have high concentration of nitrates, 23% have high concentrations of iron, and 19% have very hard water. Of these wells with high concentrations of nitrate, 70% were in shallow overburden and probably suffer contamination from surface-water runoff. Four sheets are enclosed dealing with water supplies in shallow overburden, water supplies in deep overburden, water supplies in bedrock and ground-water quality.

062523
VAN DER KAMP G, GALE JE • **Theory of earth tide and barometric effects in porous formations with compressible grains** • Water Resour Res • 19(2) 538-544 • 1983-04.

The general three-dimensional equations for pore pressure, stress, and strain in a homogeneous porous medium with compressible grains are used to derive expressions for the response of fluid pressure to the stress changes due to earth tides and barometric loading effects. The analysis constitutes a generalization of earlier derivations. The formation is assumed to be of large extent laterally so that horizontal flow may be neglected. It is shown that vertical flow induced by the pore pressure changes can be analyzed by means of a diffusion equation. An expression for the specific storage coefficient is derived which is valid if horizontal deformations are negligible and which includes the effect of the compressibility of the solid grains. Measurements of earth tide and barometric effects constitute two in situ tests of bulk formation properties. Such measurements can therefore make an important contribution to the characterization of the hydraulic and elastic properties of a particular formation.

063114
VAN EVERDINGEN RO • **Management of groundwater discharge for the solution of icing problems in the Yukon**. IN: The Roger J.E. Brown Memorial Volume • Proc Fourth Canadian Permafrost Conf, Calgary, Alta, March 2-6, 1981 • FRENCH HM • NRCC 20124 • 212-226 • Assoc Comm Geotech Res, Natl Res Counc Can, Ottawa, Ont K1A OR6 • 1982.

Icings fed by perennial discharge of groundwater cause traffic and maintenance problems at several points along the Alaska Highway in the Yukon. At the site investigated in detail (km 1817.5), slightly mineralized groundwater is being discharged at a rate of up to 9.4 cu m per hour. Isotope analyses indicate that the discharge is derived from recent precipitation. During the 1979/1980 winter, icing extended 240 m upstream from the highway, with a maximum thickness of 2.55 m and a total volume of about 14,000 cu m; icing covered the highway on several occasions. Maximum predicted icing volume for this site is 33,000 cu m, which would increase average thickness by 1.2 m and extend the icing area to about 350 m upstream from the highway. Annual expenditures for icing control at this and other icing sites can be reduced considerably (or eliminated) by improved management of groundwater discharge, through installation of subdrains, through provision of "icing-storage" areas, or some combination of these.

062448
VISOCKY AP • **Impact of Lake Michigan allocations on the Cambrian - Ordovician aquifer system** • Ground Water • 20(6) 668-674 • 1982.

Overpumping of the Cambrian-Ordovician aquifer in the Chicago area has caused severe water-level declines in portions of Cook, DuPage, Kane, and Will Counties. Recent changes in the accounting procedure for diversion of Lake Michigan water have released more water for public supplies. As communities currently withdrawing water from deep wells receive allocations of Lake Michigan water, deep pumpage will decrease in those areas and water levels will partially recover. Major cones of depression will shift southward to Joliet and westward to the Fox River communities north of Aurora. Critically low water levels caused by pumpage in these areas will result in a loss of pumping capacity of as much as 19% by the year 2020. Despite lake allocations, deep pumpage will grow again and will still exceed the practical sustained yield (65mgd/2.46 x 100,000 cu m per day) of the aquifer. Continued growth in Wisconsin pumpage will also contribute an estimated additional decline of about 80 feet near the State line between 1980 and 2020.

062955
WEYER KU, HORWOOD-BROWN WC • **Program HVRLV1 - Interactive determination of horizontal permeabilities within uniform soils from field tests using Hvorslev's formulae** • Ground Water • 20(3) 289-297 • 1982.

A computer program is presented for interactive, user-oriented calculation of permeabilities from slug tests using Hvorslev's formulae for filters in uniform soil. The analysis scheme is cost-efficient and allows for simple sensitivity analyses.

062602
WILLIAMS PJ * **The surface of the earth: an introduction of geotechnical science** * 212p * Longman, New York, NY US * 1982.

This book introduces the principles of gectechnical science for all students of the processes and forms of the earth's surface. It examines the general dynamics of the earth's surface, the relationship between materials and processes and the basic energy relations operating there, and the properties of the materials of the earth's surface such as mechanical and thermal properties of soils and rocks, soil-water relations, and the microclimatological properties of ground surface. Also to the characteristic features of specific environments: slopes, the ground immediately below the surface, the very warm regions, and the periglacial are discussed. Soil strength, heat capacities and conductivities, and microclimatic properties or quantities such as albedo, surface roughness, and various energy or mass transfer coefficients are presented.

5.2 Quality - qualite

066219
AMOCO CAN PET CO LTD, EDMONTON, ALTA * **Sugden/St. Lina heavy oil recovery project, groundwater evaluation report, Amoco Sugden water source well #1** * 67p * 1980-07-30.

In 1979, Amoco Canada drilled a test well (WSW No. 1) to act as a water supply for St. Lina Test Site (Sugden/St. Lina heavy oil recovery project). Two observation wells were used to support the testing results of WSW No. 1. A pumping test concluded a long-term yield of 76.8 igpm for WSW No. 1. The report includes an extensive appendix of raw data (electric-logs, water chemistries, pumping test calculations and graphs).

064565
BAKER BL * **Hazardous waste management** * 8p * 1980-06-24.

Disposal of waste materials in landfill areas is common practice. At the present time, since knowledge of the effects of hazardous materials is incomplete, a "best judgement" approach must be taken, based on knowledge of chemical properties, reactivity, flammability, and toxicity of the suspected materials. In recent years, studies have determined what degradative processes take place in sanitary landfill sites that may release undesirable substances. Some wastes may be harmless, but in contact with other wastes may cause reactions which pose direct hazards. Leachates, formed by liquid waste or natural precipitation percolating downward through solid wastes, can be transported beyond the boundaries of the landfill, and into the groundwater aquifers or surface watercourses. Industrial wastes, including liquids, may generate very dangerous substances in their leachates. Chemical analysis can determine the potential hazard of landfill leachates. Inorganic chemicals pose no threat except for trace metals. Organic chemicals pose the greatest threat. The report recommends: 1) that a code and labelling system be legislated for the identification of materials being delivered to a disposal site; 2) that research be conducted to approach total confinement of waste materials within the boundaries of the landfill site, to define interactions and processes occurring in landfill sites, to develop new strains of microorganisms for more efficient degradation, and to develop monitoring instrumentation; and 3) that a contingency plan be in place to handle emergencies.

066834
BEASY-NICOLL ENG LTD, INTERPROV ENG LTD * **Report to Pictou County District Planning Commission on Pictou County Regional Landfill site monitoring system and baseline water quality inventory** * 57p * Beasy-Nicoll Eng Ltd, Interprov Eng Ltd * 1982.

This report describes in detail the comprehensive monitroing system that was established in the Mount William area as part of the pre-installation assessment of the proposed regional sanitary landfill site for Pictou County. Background information supplied includes the region's geological characteristics (bedrock and surficial geology) and its effects on the natural baseline water chemistry. Sample data is tabled and analyzed from the on-site monitoring wells and from domestic monitoring wells and surface water monitoring stations. Groundwater flow, water sampling procedure, bacteriological water quality and chemical water quality are all examined in detail. Domestic wells were chosen in Mount William itself, along with wells in nearby Abercrombie and Granton. Chemical and bacteriological results from these wells are presented in tabular form. It is hoped that these results can be compared to future sample testings to determine if there has been any deterioration in the surface/groundwater quality and to hopefully discover the source of the contamination. The report includes recommendations for on-site, domestic and surface water monitoring systems, with special attention directed to sampling times, parameters and number of staticns required.

063942
CERDICI WJ * **Lamont regional landfill monitoring report** * 26p * Alta Environ, Environ Prot Serv, Earth Sci Div, Soils Branch * 1983-02.

The Lamont Regional Landfill (NW 7-56-18-W4) commenced operation in April 1982 and groundwater monitoring activities were initiated shortly afterward. This report presents the preliminary findings of the monitoring program. The predominant direction of shallow groundwater flow is towards the north-northwest. The in situ hydraulic conductivity of surficial materials and shallow bedrock ranges from 10 (sup minus 6) to 10 (sup minus 8) cm/s. Hydro-chemical data indicate that to date the landfill has not seriously degraded local groundwater quality. It is recommended that monitoring at the landfill be continued because of its regional status.

062914
CURTIS CD * **Link between aluminum mobility and destruction of secondary porosity** * Am Assoc Pet Geol Bull * 67(3) 380-384 * 1983-03.

Acid pore waters generated within organic-rich muds destabilize carbonates and aluminosilicates and take metals, including aluminum, into solution. Sediment compaction forces some of these modified pore waters into sandstones. Once isolated from the principal source of acidity (kerogen maturation), the pH of these solutions must rise as further mineral dissolution occurs. The inevitable consequence is precipitation of kaolinite, even though solutions may still be acid. This explains why kaolinite is commonly the first precipitate to reduce secondary pore space in sandstones and can form even as other minerals are being dissolved away.

063894
DARCEL FC * **Leachability of solid industrial wastes, unsaturated flow column leach tests with distilled water** * 64p * Lab Serv Branch, Ont Minist Environ * 1981-07.

Data from laboratory column leach tests on industrial wastes using distilled water in "unsaturated" flow is reviewed with respect to conformity with the penetration theory of diffusivity for tranport of soluble species. Ionic flux conformed to the theory for most ions tested for a range of types of industrial wastes, although there were a number of exceptions. Data is presented graphically for various types of waste and for specific inorganic ions, conductivity and phenol. Some wastes could be considered inert on the basis of low leachability. Bag-house dust and some abandoned mine tailings samples had high leachability of toxic metals. Factors leading to non-conformity with the penetration theory of diffusivity and limitations of the column leach test are discussed. Some considerations is given to chemical factors controlling the mobilization of inorganic species.

063888
DARCEL FC * **Solid waste leach testing in review: a perspective** * 40p * Ont Minist Environ * 1981-02.

Some aspects of the state of the art on hazard assessment, leachate movement and waste stabilization are discussed. The relative merits of batch versus column and lysimeter testing are evaluated in relation to the wide variety of procedures in use today. Scientists' concerns over attempts to standardize a test suitable for all types of waste and conditions and EPA attempts to make the EP test legally binding are discussed briefly. Some of the properties of solidified waste are considered in relation to leach procedures. Experience with leach testing at the Ontario Ministry of the Environment Laboratory Services Branch is reviewed. Limitations of the current procedure of column leaching with distilled water are discussed in relation to proposed changes in procedure and other methods of testing.

062035
DE JONG E * **The effect of a subsurface hydrophobic layer on water and salt movement** * Can J Soil Sci * 63(1) 57-65 * 1983-02.

Experiments were conducted on the effect of a hydrophobic layer, a 1:4 mixture of crude oil:soil, on water and salt movement in columns of brine-contaminated and uncontaminated soil. The mixing of oil with soil lowered water retention at low suctions, and increased saturated permeability and water repellency of the mixture. The hydrophobic layer reduced capillary rise, and increased waterholding capacity of the overlying soil. After 6 wk of intermittent leaching the salt content of the soil above and below the hydrophobic layer was lower than in the absence of this layer. The hydrophobic layer prevented resalinization of the overlying soil during a subsequent 4-wk evaporation period. The thickness of the hydrophobic layer (0.5 or 1.0 cm) did not seem important.

066530
DRAKE JJ * **The effects of geomorphology and seasonality on the chemistry of carbonate groundwater** * J Hydrol * v61 223-236 * 1983.

The equilibrium chemistry of carbonate groundwater at the regional and long-term scales of aggregation is affected by geomorphic factors and by the seasonality of temperature and recharge regions. The general trend of Ca concentration differences between regions is governed by annual mean air or groundwater temperature and by the nature of the solution system. Higher concentrations result from the coincident system where carbonate material, soil air and water are all present together and lower concentrations from

the sequential system where carbonate material occurs downstream of the soil air. Coincident systems occur in areas where carbonate material is present in the regolith (either by natural or human activity), where a porous or friable bedrock lies at shallow depth or where soils are shallow. Sequential systems occur where there is a deep non-carbonate regolith, where there is a non-carbonate cap to the carbonate bedrock or where there is a high water table. Reductions in equilibrium Ca concentration can be caused by low soil-air volumes relative to percolation volume. This may be particularly significant in cool regions, where soils are shallow and clayey, and where recharge occurs in short high-intensity events.

066532
DRAKE JJ * **Groundwater chemistry in the Schefferville, Quebec iron deposits** * Catena * 10(1/2) 149-148 * 1983-03 * 1983-03.

Input precipitation quality, soil clay mineral reactions and aquifer mineral dissolution control the quality of groundwater in an area of discontinuous permafrost in the Labrador Trough iron deposits near Schefferville, Quebec. Na and Cl are derived from precipitation and K from clay minerals. Ca, Mg and HCO3 concentrations and pH are governed by the extent of mixing of saturated water from a dolomite unit with water from other, non-carbonate units. Local conditions govern the equilibrium concentrations in the dolomite-saturated water. On ridge tops carbonate materials are absent and the closed-system evolution path is followed but in one lower area, where a carbonate-containing till is present, evolution is open-system. Iron species concentrations and pE values suggest that groundwater in equilibrium with the iron oxyhydroxide minerals is anoxic. Groundwater temperatures are similar to the annual recharge temperature (4.7C) and pumping associated with mining may cause an alteration in the permafrost distribution by inducing groundwater flow.

064875
FARQUHAR GF, SYKES JF * **Assessing the impact of waste disposal on groundwater quality, Chapter 38** , IN: Waste Treatment and Utilization, Theory and Practice of Waste Management 2, Proc Second Int Symp Univ Waterloo, Waterloo, Ont, June 18-20, 1980 * MOO-YOUNG M, ROBINSON CW, FARQUHAR GJ * 503-523 * Pergamon Press, Toronto, Ont * 1982.

This paper discusses the impact assessment of waste disposal on groundwater quality. Of concern is the extent of contaminant transport in time and space as compared to environmental standards. The factors which affect contaminant transport are examined. They include leachate contaminant loading, patterns of groundwater movement and processes which attenuate contaminant concentrations during transport. Emphasis is placed on the attenuating mechanisms of dispersion, adsorption, precipitation and biological activity. Modelling contaminant migration in groundwater systems is also discussed. Examples of modelling Cl, K and COD are presented together with comparisons to field data.

065301
FRALICK PW * **A model for the concentration processes of arsenic in well waters of Nova Scotia, Canada** * Inst Resour and Environ Stud Discuss Pap 80-2 * 47p * Inst Resour and Environ Stud, Dalhousie Univ, Halifax, NS B3H 1W7 * 1980-04.

Arsenic contamination has been recognized as a major problem in Nova Scotia during the 1970's. The roots of the problem lie with the Meguma Group, the rock type underlying large areas in the southeastern portion of the province. This unit has naturally high arsenic values which were acquired during its deposition. The arsenic accumulated both as clastic detritus and as a precipitate from the water column. Arsenic in solution also tended to be absorbed onto clays causing higher concentrations in the finer grain-sized sediment. Remobilization of this arsenic during vein formation and the mining of these veins for the gold also associated with them caused areas of extremely high arsenic concentration to develop both in the rock mass and the environment as a whole. Other human activities, such as quarrying, construction, etc., have also caused increased leeching of arsenic and have led to high concentrations in well water. In an attempt to understand the relative importance of these contributing agents R-mode factor analysis was employed. It indicated that a well's proximity to a mining area and the grain size of the underlying rock type were the two major variables controlling arsenic concentration. This necessitates a reevaluation of the government's well water sampling program, as only wells in gold mining districts were sampled for arsenic. Even though now all new wells are being analyzed for arsenic, there is a need to survey existing wells in areas underlain by Halifax Slate.

066735
GIBB JE, MCMULLIN KA * **Regional water resources Pictou County Nova Scotia** (see chapter 2 for complete reference - voir chapitre 2 pour la reference complete)

F11782
GREEN D * **Une analyse ecologique du probleme des dechets dangereux** * L'environnement * 9(02) 2-6 * 1982-05.

Cet article s'attarde au probleme de la gestion des dechets industriels toxiques.

L'auteur critique la position du ministere de l'Environnement du Canada qu'il considere comme trop permissive et rappelle pour corroborer son opinion quelques exemples de contamination des eaux souterraines au Canada. Il decrit les risques encourus par les populations locales par la mise sur pied de centres de traitement des dechets dangereux. L'auteur previlegie l'action preventive comme outil de gestion, action qui se traduit par une diminution et un remplacement progressif des substances dangereuses utilisees actuellement.

063781
GUVANASEN V, VOLKER RE * **Experimental investigations of unconfined aquifer pollution from recharge basins** * Water Resour Res * 19(3) 707-717 * 1983-06.

Experiments in a sand-filled flume simulate contaminant movement in an unconfined aquifer from a long strip recharge basin. Sodium chloride is used as a tracer with its distribution being monitored via electrical conductivity measurements controlled and stored through a minicomputer. The effects of initial saturated depth and magnitude of the recharge rate on the pattern of contaminant movement are discussed. Comparisons with results from numerical models are provided for the speed of movement of the contaminant front and the thickness of the mixing zone as well as for the rise in the free surface level.

066080
HART JN * **An investigation of the quantity and quality of leachate from a highway salt treated sand pile** . IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * v1 135-155 * Can Soc Civ Eng * (1981).

The New Brunswick Departments of Transportation and Environment have been experiencing increasing costs in handling groundwater contamination problems due to salt used as a de-icing compound. This report summarizes the results of two years of monitoring leachate water from a salt-treated sand pile operated by the New Brunswick Department of Transportation. Such stock piles are commonly used by this Department and municipalities for maintenance of roads in winter. The objective of the project was to provide an accurate measure of the amount of salt lost by solution from a typical uncovered salt treated sand pile and to make appropriate recommendations on how to control this salt loss. During the 1975 - 76 project year 18.1 tons or 33 percent of the original 55 tons of salt used was lost via solution. In the 1976 - 77 project year 25.9 tons or 57.3 percent of the original 45 tons of salt was lots. The loss of salt can be decreased substantially by controlling the amount of precipitation that comes in direct contact with the salt treated sand pile.

062451
HENDRY MJ, PATERSON BA * **Relationships between saturated hydraulic conductivity and some physical and chemical properties** * Ground Water * 20(5) 604-605 * 1982.

Multiple regression analyses produced low R sup 2 values of measured physical and chemical parameters and saturated hydraulic conductivities (K sat) for southern Alberta soils. We concluded that these physical and chemical parameters are inappropriate in themselves for estimating laboratory or field-determined saturated hydraulic conductivities under southern Alberta conditions and that other factors which may exert greater control on K sat (i.e., structure) should be included in the regression analyses.

062449
HILL AR * **Nitrate distribution in the ground water of the Alliston Region of Ontario, Canada** * Ground Water * 20(6) 696-702 * 1982.

Nitrate-N concentrations during the Summers of 1980 and 1981 exceeded 10 mg/l in 68 of the 164 groundwater samples collected from a shallow water-table aquifer underlying a sand plain near Alliston, Ontario. Three extensive zones of nitrate contamination were associated with major potato-growing areas on the sand plain. Nitrate concentrations were positively correlated with both the percentage area of heavily fertilized crops (potatoes, corn, sod and asparagus) and nitrogen fertilizer application rates in the vicinity of ground-water sampling sites. Chloride levels in ground water exhibited a positive association with KCl fertilizer application rates. Ground water under potato fields had relatively consistent Cl/NO3-N ratios despite considerable variations in nitrate-N and chloride concentrations. Ground water with a low nitrate content was found beneath forest and permanent pasture. These data suggest that the use of commercial nitrogen fertilizer is a major source of nitrate in the aquifer.

066714
HJ PORTER AND ASSOC LTD * **Final report - Pugwash groundwater exploration program** * vp * HJ Porter and Assoc Ltd, 5212 Sackville St, Halifax, NS B3J 1K6 * 1982-03.

In 1980 it was confirmed that salt water intrusion was occurring in wells in the village of Pugwash. This report presents the results of a groundwater drilling and testing program carried out in 1982. Three observation wells were drilled in the area, and estimates of future water demand for the village were made. Results of pump test analyses using methods by Theis and Jacob are outlined in the report. Chemical analysis was performed on six water samples to determine the water quality. All of the data gathered from the observation wells is included in the report.

066028
HJ PORTER ASSOC LTD * **Project LUM 1, groundwater capability: urbanizing areas of Lunenburg municipality** (see chapter 5.1 for complete reference - voir chapitre 5.1 pour la reference complete)

065480
HYNES HBN * **Groundwater and stream ecology** * Hydrobiologia * v100 93-99 * 1983.

In the light of findings in recent years about the extent and nature of the hyporheal zone, the rate of uptake of organic matter by stream beds, and the face that groundwater contains dissolved organic matter, it is suggested that stream ecologists should learn much more than they now know about groundwater. It seems probable that it is an important source of organic matter to the stream ecosystem which has escaped consideration to date.

067122
JACOBSON JS, TROIANO JJ * **Dose-response functions for effects of acidic precipitation on vegetation** * Water Qual Bull * 8(2) 67-71, 109 * WHO Collab Cent Surface Ground Water Qual, Can Cent Inland Waters, Burlington, Ont * 1983-04.

This article describes some aspects of the phytotoxicity of acidic precipitation and proposes some improvements in experimental approaches in order to develop accurate dose-plant response functions. Fundamental concepts of the relationship between toxic agents and organisms which provide criteria for evaluating the effects of acidic precipitation, are discussed. These include basic principles of dose-response relationships, measures of dose, and temporal factors of rainfall that may affect plant response. The critical issue in scientific research is seen as the need to predict the effects on crop growth with contamination at, above, and below current levels so that the benefits and costs of less and more polluted rain could be determined. Some experimental considerations examined are determining the response surface, model response surfaces, range of treatments, field and greenhouse studies, and improvements in field experiments. The development of hypotheses from empirical relationships to provide a basis for investigating the mechanisms of action of acidic rain, is described. It is concluded that direct demonstration of harmful effects to plants by ambient acidic rain in North America is still needed.

066715
JACQUES, WHITFORD AND ASSOC LTD * **Report to Nova Scotia Power Corporation on hydrogeological study Lingan, Nova Scotia, volume I and II** * vp * Jacques, Whitford And Assoc Ltd * 1982-02-05.

This study was carried out due to plans by the Nova Scotia Power Corporation to dispose of ash at a proposed site west of the Lingan generating station. To assess the impact of the disposal site, this environmental study was commissioned to obtain baseline chemistry of the groundwater, leachate and ash. Groundwater flow was determined and the data evaluated to make recommendations relative to the environmental aspects for the development of the ash landfill site. The general rates of ash production are examined along with the proposed landfill operations. The surficial and bedrock geology, and hydrogeology of the area are discussed. Water quality in the immediate vicinity is described in some detail. Environmental considerations concerning the proposed ash disposal are examined.

061886
JAME YW, NICHOLAICHUK W, LEYSHON AJ, CAMPBELL CA * **Boron concentration in the soil solution under irrigation: a theoretical analysis** * Can J Soil Sci * 62(3) 461-470 * 1982-08.

Current irrigation water criteria for boron (B) are based upon the B concentration of either the irrigation water or the soil saturation extract. The effects of the leaching fraction (LF) and the boron adsorption capacity (BAC) of the soil upon the soil solution concentration have not been considered. The objectives of this paper were (i) to develop a predictive model relating soil solution B concentration at equilibrium to the B concentration in irrigation water and the LF, and (ii) to show how the relationship between the B concentration of the soil solution under field conditions and the B concentration of the soil saturation extract can be modelled. The predictive model, derived from the mass balance concept, indicated that at equilibrium the value of the soil solution B in well-drained soil would be close to that of irrigation water, at the soil surface and will increase with depth with the highest value being near the bottom of the root zone where its magnitude is determined primarily on the degree of leaching. For irrigation water concentrations between 0.5 and 10 mg B/L, the weighted average B concentration of the soil solution in the profile of an alfalfa field would be about 1.9-2.7 times the irrigation water concentration at a LF of 0.1; it would be 1.4-1.9 times for a LF of 0.25; and 1.3-1.5 times for a LF of 0.4. The model of the relationship between soil solution B at field capacity and saturation extract B indicates the importance of the BAC of the soil. Without considering BAC, the ratio between the two would be 2. However, the model indicates that the ratio ranges from 1.0 to 1.8 depending upon the B concentration in the solution and the BAC of the soil. This suggests that the B concentration of the soil saturation extract does not provide a true

representation of the soil solution B. In assessing B toxicity, the saturation extract concentration should be converted to the soil solution concentration at the actual water content of the soil.

065509
JORDAN GW * **Lacombe Regional Landfill Site (proposed), NW 29-40-27-W4, Lacombe, Alberta** * 25p * Alberta Environ, Environ Prot Serv, Earth Sci Div, Soils Branch * 1980-12.

At the request of the Town of Lacombe, a hydrogeological investigation was undertaken at NW 20-4--27-W4 by the Soils Branch, Earth Sciences Division, Alberta Environment. The purpose of the study was to determine the suitability of the area for a regional landfill site. Although the site is located near a major drainage divide, and part of the area is underlain by sand and gravel deposits, a total area of approximately 45 ha (110 acres) is acceptable for landfill development. The risk of groundwater contamination is minimal provided the recommendations contained in the report are followed.

065337
KAY BD, GROENEVELT PH * **Development of a model to describe subsurface transport of solutes as a consequence of freezing conditions, final report** * 40p * 1983-01-15.

The objectives of this study are: to describe quantitatively the principal mechanisms whereby freezing of the soil surface influences the transport of solutes in soil systems; and to incorporate this description into models to describe the transport of water in freezing soils. The study consisted of field and laboratory measurements, and the development of appropriate theory. Field studies were carried out to confirm the significance of ground freezing on solute redistribution. Redistribution occurs as a consequence of water flow up into the frozen zone with resulting ice lens formation. The field data could not confirm the significance of other mechanisms in the redistribution process. One of these other mechanisms, solute exclusion by an advancing freezing front, was studied in the lab. Freezing induced by a step change in temperature resulted in virtually no exclusion on a macroscopic basis; the solute appeared to be concentrated in bands within the frozen zone. A mathematical description of the rate of advance of a freezing front under conditions in which the solute has not been excluded has been developed. This theory was applied to the laboratory data, and illustrates the validity of the assumptions on which the model is based.

066079
KELLY DM, KEEFE JD, RAFUSE IN * **Groundwater resource evaluation Charlottetown Airport redevelopment project** , IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * vi 113-134 * Can Soc Civ Eng * (1981).

A number of water related concerns including the need for the management and protection of groundwater resources adjacent to the Charlottetown Airport redevelopment project were identified. The concerns were raised because the facilities are situated on the headwaters of the well fields which supply water to the City of Charlottetown. Therefore, the potential impairment of water quality resulting from the use of urea, hydrocarbons, phenols/glycol could pose a serious economic burden on the City. The study evaluates: groundwater flow patterns within and adjacent to the airport property to determine potential contaminant migration paths; and, the degree of natural protection afforded by soil cover. Seasonal baseline variations in water quality were established to assess water quality changes following redevelopment. A series of recommendations ensuring that the redevelopment would proceed in an environmentally acceptable fashion are outlined (on-site oil storage, design consideration for the fire training facilities, alternative pollution abatement strategies and the need for future monitoring).

067138
KELSO BW, JONES M * **Progress report on the December 7, 1982 water quality sampling in Myra Creek after the implementation of the groundwater and surface collection and treatment system at Westmin Resources Limited on Vancouver Island** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

063110
LEWKOWICZ AG, FRENCH HM * **Downslope water movement and solute concentrations within the active layer, Banks Island, N.W.T.** , IN: The Roger J.E. Brown Memorial Volume * Proc Fourth Canadian Permafrost Conf, Calgary, Alta, March 2-6, 1981 * FRENCH HM * NRCC 20124 * 163-172 * Assoc Comm Geotech Res, Natl Res Counc Can, Ottawa, Ont K1A OR6 * 1982.

Subsurface water movement and solute concentrations were measured during the summers of 1977, 1978, and 1979 on two slopes with small runoff plots, located in the vicinity of the Thomsen River, north-central Banks Island. At two other instrumented plots, subsurface-flow volumes were estimated from water-balance studies. The results show that the relative importance of subsurface flow in the water balance of individual plots varied both at daily and seasonal time scales. On all slopes, however, snowmelt was the major source of water supply, and flow declined very rapidly after the end of snow ablation. In general, the values of solute concentrations

in subsurface wash were high. Concentrations tended to increase within the active layer. Seasonal trends in concentrations at any one depth included relatively low values during most of the snowmelt period, an increase in the ten days that followed, and a "plateau" concentration attained at very low discharges. The total weights of solutes removed from the plots by subsurface flow during the snowmelt season were large, with a maximum of 43 g/sq m in 1978 at the site of the largest snowbank. Using a dry bulk density of 1.5 Mg/cu m, this figure corresponds to a denudation rate of 29 mm/1000 years. The removal of materials in solution by subsurface flow is thus regarded as an important geomorphological process in this area of the Arctic.

063063
LILLEY J * **Dryland salinity in Alberta** * 39p * Environ Counc Alta, 8th Floor Weber Cent, 5555 Calgary Trail, Edmonton, Alta T6H 5P9 * 1982-03.

This report discusses the causes of saline seeps and possible reclamation processes. The emphasis is on what is being done, the successes, problems, and implications of saline seep control. The causes of dryland salinity are closely related to groundwater movements and the geology of Alberta. The main salts in dryland seeps are magnesium and sodium sulfates. The increase in dryland salinity is due mostly to the extensive use of summerfallow. In Alberta saline seeps are most likely to occur where the soil parent material is high in soluble salts, the annual precipitation is less than 20 inches, and summerfallowing is practised extensively. An estimated 500,000 acres in Alberta are affected by saline seeps. At the provincial level, the minimum loss in annual income due to reduced yields on 500,000 acres of severely salinized land is $25,000,000. Several reclamation techniques are described, however there is no widespread implementation of these in Alberta. Reasons are given for Alberta farmers continuing to summerfallow and possible actions to improve the control of dryland salinity are discussed.

066695
LORBERG EF * **Groundwater component of the South Saskatchewan River basin in Alberta** (see chapter 5.1 for complete reference - voir chapitre 5.1 pour la reference complete)

066745
MCCURDY RF * **Groundwater variations in arsenic (III) and arsenic (V)** * 142p * Tech University of NS, Halifax, NS * 1980.

Methods are described whereby arsenic (III) and arsenic (V) are selectively extracted in the field. In one procedure arsenic (III) is chelated with APDC, buffered with acetate and extracted into M1BK. In the other procedure, arsenic (V) is chelated with ammonium molybdate, acidified with sulfuric acid and extracted into M1BK. The arsenic content of each extract is determined by graphite furnace atomic absorption spectrometry. Factors including precision, accuracy, extraction selectivity, optimum pH and acidity, sample temperature and the presence of interfering ions in the presence of EDTA have been considered. Procedures are also described for the determination of monomethyl and dimethyl arsenic acid in water. The stability of arsenic (III) and arsenic (V) in a collected water sample is discussed. Factors including storage temperature, sample filtration and preservation with acid have been considered. A study describing temporal and spatial variations in arsenic (III) and arsenic (V) is presented. The variation in arsenic (III) and arsenic (V) at four sampling stations for one year has been studied. Factors including changes in water pH and Eh, and static water level and antecedent rainfall have been considered. Variations in arsenic (III) and arsenic (V) at 213 sampling stations in Waverley have also been studied. The influence of such factors as well depth and water quality factors are discussed.

064750
MINIST ENVIRON, WATER RES BRANCH * **Water resources of the Holland and Black River basins - Summary** (see chapter 2 for complete reference - voir chapitre 2 pour la reference complete)

064259
MORAN SR, HOWARD A, MACYK T, MASLOWSKI A, TRUDELL M, WALLICK EI * **Assessment of reclamation potential and hydrologic impact of large-scale surface mining of coal in plains areas of Alberta: summary report of activities 1982-83** * 74p * (Alta Res Counc) * 1983-03.

This report presents the accumulated results of four years research into hydrogeological and hydrogeochemical processes involved in mining and reclamation of surface coal mines in the plains of Alberta. The focus of the report is specifically on progress during fiscal 1982-83. The report presents a general overview of the direction of the project and a simple statement of project objectives. A summary statement of results and conclusions of the research as they bear on the objectives and subobjectives of the project is presented. In most cases, these conclusions are an abstraction based on a large amount of data and a number of more discipline-specific conclusions that are discussed and summarized in the appendices to the report. Also presented is a summary of progress of activities related to each subobjective on the basis of individual terms of reference. The results and conclusions from these various studies are summarized in the

appendices. The report summarizes financial status of the project as of the end of January 1983 and progress against the schedule to the end of February. The final section of the report consists of 25 appendices that contain the specific technical data accumulated by the project. Some of these appendices consist of purely data and a page or two of explanation. Others consist of published or manuscript reports that summarize a segment of the work bearing on one or more of the subobjectives. The appendices are in four volumes, separate from the report.

061765
NAGPAL NK * **Comparison among and evaluation of ceramic porous cup soil water samplers for nutrient transport studies** * Can J Soil Sci * 62(4) 685-694 * 1982-11.

The use of commercially available porous cup soil water samplers for soil solution extraction was evaluated. Ortho-P, (NO3 + NO2)-N and potassium (K) were adsorbed by the porous cup during extraction of soil water samples, but the retention of (NO3 + NO2)-N was minimal. The screening of NO3- by the cup was not obvious. The retention of ortho-P and K was a function of solution concentration and the time of contact between soil solution and the cup. A rest period between extractions, during which samplers remained in contact with solution at zero tension, appeared to enhance phosphorus sorption capacity of the ceramic cup. Furthermore, phosphorus sorption was reversible in nature. The porous cup subjected to high solution concentration initially, released phosphorus when flushed with soil solution of low concentration. It is recommended that several consecutive soil water extractions be carried out at high (0.6 bar) tension, using high flow rate porous cups. The sample collected in the last extraction should be used to determine true soil water quality.

066718
NOLAN DAVIS AND ASSOC LTD * **A hydrogeological-engineering investigation of the MacKenzie Property, River Denys to determine its suitability for disposal of domestic solid waste** * vp * Nolan Davis and Assoc Ltd, PO Box 1021, Halifax, NS B3L 4K9 * 1982-10-12.

The purpose of this study was to determine the feasibility of utilizing the study site as a sanitary landfill for domestic solid wastes generated within Inverness County south. The site was assessed in terms of its ability to primarily minimize environmental risk. The bedrock and surficial geology of the study area were examined in the report. Soils of the area and the physiography are also discussed. The report contains a discussion of surface water and groundwater hydrology. Contaminants already disposed of in the area and future contaminant disposal are examined.

065624
NOLAN, DAVIS AND ASSOC LTD * **Geologic and environmental geologic assessment of the proposed expansion of the existing Baddeck landfill site** * 17p * Nolan, Davis Assoc Ltd, 19 Mosher Dr, Dartmouth, NS B3B 1E5 * 1981-07-20.

An expansion of the existing landfill site at Beddeck, Cape Breton Island has been proposed. This report assesses the geologic and environmental geology of the proposed site. Nine test pits were excavated in November 1980 and two more in May 1981. Sieve and hydrometer analyses and moisture content determinations were conducted and the surficial geology described. The proposed expansion and the existing landfill site are both located within the Mabou Formation. The silt-clay till which generally overlies the proposed expansion site is considered and aquitard rather than an aquifer unit. The hydraulic conductivity tests indicate the relative impermeable nature of the surficial materials. It was not possible to establish the position of the water table or potentiometric surface. Seven surface water samples were collected in the area of the existing and proposed landfill site to provide complete chemical baseline information for the proposed site. All samples were analyzed for complete chemical and trace metal parameters. The samples indicate the streams can be classified either as sodium chloride or calcium sulphate type waters. Sediment geochemistry results indicate that to date none of the streams in the vicinity of the site have been seriously effected. It is concluded that the proposed site should provide a suitable disposal site for garbage of a domestic nature although additional work will be required to substantiate this supposition. And, drilled wells west of the landfill site are unlikely to be affected unless there is gross contamination of the bedrock aquifer.

065845
ONT MINIST ENVIRON, WATER RESOUR BRANCH, HYDROL MONIT SECT * **A feasibility study for augmenting Avon River flow by ground water** (see chapter 4.1 for complete reference - voir chapitre 4.1 pour la reference complete)

064225
PENTTINEN S * **A compilation of data with respect to industrial waste water disposed of by deep well injection** *11p * 4 tab, 8 ref, * 1980-09-23.

In view of current interest to expand oil refinery capacity in order to accommodate the upgrading of synthetic and conventional crude oil for domestic demand, a brief assessment of disposal well liquid effluent data has been undertaken by the Water Quality Branch in order to provide information relating to issuance of permits and licences of pending

refinery proposals. This report also summarizes present approved practices by the oil and gas and chemical sectors. The chemical characteristics and quantity of liquid effluent data included in the summary are routinely monitored in relation to the reporting requirements of licences issued under The Clean Water Act for those specific industrial sectors that discharge materials into subsurface formations as well as to receiving waters. Approved deep well injection systems (which meet the requirements of existing legislation under the Energy Resources Conservation Board) provide a disposal technique that is considered acceptable and also represents a viable component of a integrated total waste water management system which is subject to review under The Clean Water Act. The determination of the treatability of water contaminants on the surface and subsequent discharge to watercourses is primarily site dependent and therefore a function of the specific industrial process and related to assessment on a case by case basis.

062952
PICKENS JF, JACKSON RE, INCH KJ, MERRITT WF * **Measurement of distribution coefficients using a radial injection dual-tracer test** * Water Resour Res * 17(3) 529-544 * 1981-06.

The dispersive and adsorptive properties of a sandy aquifer were evaluated by using a radial injection dual-tracer test with 131I as the nonreactive tracer and 85Sr as the reactive tracer. The tracer migration was monitored by using multilevel point-sampling devices located at various radial distances and depths. Nonequilibrium physical and chemical adsorption effects for 85Sr were treated as a spreading or dispersion mechanism in the breakthrough curve analysis. The resulting effective dispersivity values for 85Sr (range of 0.7-3.3 cm; mean of 1.9 cm) were typically a factor of 2-5 larger than those obtained for 131I (range of 0.4-1.5 cm; mean of 0.8). The distribution coefficient (KdSr) values obtained from analysis of the breakthrough curves at three depths and two radial distances ranged from 2.6 to 4.5 ml/g. These compare favorably with values obtained by separation of fluids from solids in sediment cores (4.3-11.7 ml/g), by batch experiments on core sediments (2.8-10.8 ml/g), and by analysis of a 25-year-old radioactive waste plume (mean of approximately equal to 10 ml/g.) in another part of the same aquifer. Correlations of adsorbed 85Sr radioactivity with grain size fractions demonstrated preferential adsorption to the coarsest fraction (associated with micaceous minerals) and to the finest fraction. The relative amounts of electrostatically and specifically adsorbed 85Sr on the aquifer sediments were determined with desorption experiments on core sediments using selective chemical extractants. The withdrawal phase breakthrough curves for the well, obtained immediately following the injection phase, showed essentially full tracer recoveries for both 131I and 85Sr. Relatively slow desorption of 85Sr, indicated by extreme tailing of the return breakthrough curve and analysis of residual radioactivity on sediment cores, provided further indication of the nonequilibrium nature of the adsorption-desorption phenomena.

066734
PORTER RJ * **Regional water resources Southwestern Nova Scotia** (see chapter 2 for complete reference - voir chapitre 2 pour la reference complete)

062252
RICHARDS PAL * **The polarographic speciation of iron in a natural groundwater environment** * 155p * Dep Geol Sci, Queen's Univ, Kingston, Ont * 1982-04.

A field polarographic method for the speciation of iron in a groundwater aquifer is developed. Sampled DC polarography, when compared with the analytical techniques of normal and differential pulse polarography, demonstrated an inherent clarity in the definition and interpretation of ferrous - ferric ratios in synthetic and natural groundwaters. A technique of interpretation of polarographic data, based on a time - domain analysis of the limiting diffusion currents, indicated that an accurate determination of the original ferrous - ferric ratio, in solutions experiencing continual oxidation of the ferrous species, was possible. The determination of the original ferrous - ferric species activities allowed the construction of pE - pH diagrams (based on speciation considerations) which differed somewhat from previously published data for the study area (the Perch Lake aquifer, Chalk River, Ontario). Redox potentials, determined through polarographic analysis, demonstrated that field electrode measurements taken in the study area are consistently higher than the redox potential of the ferrous ion - ferric oxyhydroxide redox couple.

062452
RUSSELL DJ, GALE JE * **Radioactive waste disposal in the sedimentary rocks of Southern Ontario** * Geosci Can * 9(4) 200-207 * 1982-12.

This paper is the first published examination of the Paleozoic sedimentary sequence of southern Ontario as a radioactive waste disposal medium. A major asset in siting a repository in such a sequence is the ability to locate zones with favourable geotechnical properties in suitable hydrogeologic environments by application of a large data base to the relatively simple stratigraphic model. A review of the

stratigraphy, and the geotechnical and hydrogeologic properties of shales in the sequence reveals several zones of interest for waste disposal purposes. The most significant factor controlling suitability of an area for repository siting is the regional flow pattern. As a start in examining this factor, ten hydrostratigraphic units, distinguished by hydrogeologic properties alone, are proposed and used in a first attempt at evaluating the deep flow regime in southern Ontario.

066738
SHAWINIGAN ENG MARITIMES LTD * **Groundwater protection guidelines in Nova Scotia** * 213p * Shawinigan Eng Maritimes Ltd, 11 Morris Dr, Suite 212, Dartmouth, NS B3B 1M2 * 1980-06.

This document was prepared for the Nova Scotia Department of the Environment to provide the basis for establishing comprehensive groundwater protection guidelines for the province. A broad description of groundwater and the relationship of groundwater to man's activities is presented and a comprehensive basis for the protection of groundwater is established. The groundwater situation in Nova Scotia, both in terms of its physical characteristics and existing management techniques, is examined. Recommendations are made on the technical requirements needed for the implementation of groundwater protection guidelines in Nova Scotia. Specific guidelines designed to protect Nova Scotia groundwater resources threatened by activities ranging from sewage disposal systems, to solid waste disposal, fertilizers, pesticides, mining and highway construction are detailed.

066604
SNEDDON DT * **Hydrotechnical research in the Alberta Oil Sands** * Uned Mater OF 50 * 34p * Alberta Environ, Res Manage Div * 1983-01.

Hydrotechnical research in the Alberta Oil Sands has been oriented toward establishment of baseline (i.e. predevelopment) environmental conditions and identification of contaminant transport mechanisms. Monitoring networks for both groundwaters and surface waters are in place and both water yield and quality are being observed. Plans are being made for research into groundwater/surface water interaction and into the geomechanical consequences of in situ extraction of bitumen using high pressure, high temperature steam injection techniques.

064244
TRUDELL M * **Assessment of reclamation potential and hydrologic impact of large-scale surface mining of coal in plains areas of Alberta: summary report of activities 1982-83, Appendix T, Chemistry of infiltration water at the Battle River Site - Preliminary report** * 6p * (Alta Res Counc) * 1983-02.

Porous cup soil moisture samplers were installed at several sites in both reclaimed and undisturbed settings in the Battle River area of Alberta. The soil moisture chemistry at undisturbed sites is generally characterized by sodium as the dominant cation, with bicarbonate or sulfate as the dominant anions. The soil moisture samples collected from spoil at Diplomat Mine was as consistent in composition as the samples from unmined material were variable. In most cases the soil moisture at Diplomat Mine has a Ca^{2+}-Mg^{2+}-$SO_4^{=}$ composition, although salinity tends to vary from site to site. Results are briefly given of sampling at each site. Two samples of soil moisture collected from spoil at Vesta Mine have a Na^{+}-$SO_4^{=}$ composition. This water chemistry is within the range of values recorded in the groundwater. This suggests that the compositional characteristics of Vesta spoil groundwater may be established at relatively shallow depths, since groundwater composition and salinity are generally in the same range as these soil moisture samples.

064243
TRUDELL MR * **Assessment of reclamation potential and hydrologic impact of large-scale surface mining of coal in plains areas of Alberta: summary report of activities 1982-83, Appendix S, Characterization of surface water and evaluation of contamination by spoil groundwater discharge at the Battle River Site** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

064242
TRUDELL MR * **Assessment of reclamation potential and hydrologic impact of large-scale surface mining of coal in plains areas of Alberta: summary report of activities 1982-83, Appendix R, Spoil groundwater migration - Vesta Mine** * 14p * (Alta Res Counc) * 1983-02.

Work conducted at and adjacent to Vesta Mine in the Battle River area of central Alberta in 1981-82 identified contamination of groundwater based on chemical and isotopic analysis of groundwater in the Battle River Bed and drift at site BR-10. To define the extent of this spoil groundwater "plume", five piezometer nests were installed in unmined material in close proximity to Vesta Mine. Each nest consisted of a piezometer completed in the Battle River Bed, and one completed in the drift. Where present, sand horizons within the drift were selected for monitoring, since any water from the spoil would likely move preferentially through these more permeable zones. Preliminary results of monitoring which began in December of 1982 are presented.

064247
TRUDELL MR * **Assessment of reclamation potential and hydrologic impact of large-scale surface mining of coal in plains areas of Alberta: summary report of activities 1982-83, Appendix Y, Spoil hydrology and hydrogeochemistry, Highvale Site** * 14p * (Alta Res Counc) * 1983-02.

Results are presented of a preliminary analysis of the hydraulic head distribution, groundwater flow patterns, and chemical makeup of spoil groundwater in Highvale Mine, Pit 01 and in spoil groundwater at Whitewood Mine. On the basis of major ion analyses of samples from Highvale Pit 01, a number of trends became evident, as indicated on a Piper trilinear diagram. Sodium is the dominant cation, while the dominant anion is either bicarbonate or sulfate. In general, the salinity of the spoil groundwater is related to its position within the spoil and in addition, the higher salinity samples tend to be dominated by sulfate.

064251
TRUDELL MR * **Assessment of reclamation potential and hydrologic impact of large-scale surface mining of coal in plains aruas of Alberta: summary report of activities 1982-83, Appendix A-2, Battle River spoil groundwater chemistry, March, 1983 update** * 3p * (Alta Res Counc) * 1983-02.

The sampling of eighteen previously unsampled wells from spoil at Diplomat Mine 1982, in addition to the re-sampling of previously tested wells, has provided additional data in support of the spoil groundwater chemical trends previously reported. The new sample analyses confirm that the groundwater flow system along the base of the spoil is a continuous feature. The new samples also confirm the presence of a more calcic, higher salinity spoil groundwater zone within the middle and upper parts of the spoil. A student's t-test analysis of total dissolved solids concentration distribution for the two groups of Diplomat spoil water indicates that they are statistically different at the 99% confidence level. The water chemistry at one of the new sampling sites showed a deviation from the general pattern in the Diplomat spoil. At this site, the shallow groundwater was low in salinity, while at the base of the spoil, the water was more saline. The spoil at this particular site probably represents a more active, better flushed part of the flow system than most of the spoil. The sampling program for spoil wells at Vesta Mine during 1982 consisted of a second round of sample collection for each well, in which few changes in water chemistry were noted.

064241
TRUDELL MR * **Assessment of reclamation potential and hydrologic impact of large-scale surface mining of coal in plains areas of Alberta: summary report of activities 1982-83, Appendix Q, Pre-mining groundwater conditions at the Battle River Site** * 53p * (Alta Res Counc) * 1983-02.

A detailed description is presented of groundwater flow and groundwater chemistry in the aquifers and aquitards in the Battle River area of Alberta. Three laterally continuous coal seams have been identified in the area: the uppermost is the Paintearth Bed, the lower seam is the Battle River Bed, while in between is the Marker Bed. The Paintearth Bed is overlain by the Paintearth Interval. Between the Paintearth Bed and Marker Bed is the Marker Interval and between the Marker Bed and the Battle River Bed is a sequence of interbedded siltstones and shales called the Battle River Interval. These fine-grained sequences - the Paintearth, Marker, and Battle River Intervals, form the principle aquitards in the Battle River area. Underlying the Battle River Bed is the Delta Sandstone and below it are three sandstone units: the Middle Sandstone, Deep Sandstone and Basal Sandstone. A general overview is given of groundwater flow and chemistry, followed by a description of the glacial drift in the Battle River area. Finally, a detailed description is given of the groundwater flow and chemical characteristics of each of the aquifers or aquitards.

064253
TRUDELL MR, CHEEL DB * **Assessment of reclamation potential and hydrologic impact of large-scale surface mining of coal in plains areas of Alberta: summary report of activities 1982-83, Appendix C, Preliminary report on ash leaching studies and interaction of ash in the spoil groundwater environment** * 16p * (Alta Res Counc) * 1983-02.

This report describes a study to determine what long-term effects the weathering of ash has on the spoil groundwater in contact with it. Examples of such effects include the solubilization of major ions and trace elements, and the possibility of adsorptive properties in the ash. A modified Celstir experiment was used in the study. The procedures followed are outlined briefly and the results are summarized and discussed. The results show the effects of weathering of both fly and bottom ashes in a high CO2 environment on spoil groundwater and distilled water. The primary effect of ash is with the anionic constituents. There is a shift to higher sulfate content with a corresponding decrease in the bicarbonate content. Chloride does not contribute significantly to the groundwater either before or after treatment with ash. Analysis for trace elements were also executed on the groundwaters and the ash treated waters. For the natural spoil groundwaters, all trace element concentrations except mercury were under the recommended limits. It was concluded that the disposal of fly ash and

bottom ash presents two problems: high salinity, and trace element toxicity. Very high concentrations of boron and selenium may result from the contact of water and fly ash, and high concentrations of boron may be produced from bottom ash.

064249
TRUDELL MR, FAUGHT RL * **Assessment of reclamation potential and hydrologic impact of large-scale surface mining of coal in plains areas of Alberta: summary report of activities 1982-83, Appendix X, Characterization of spoil groundwater chemistry at the Battle River Site** * 22p * (Alta Res Counc) * 1983-02.

Groundwater samples were obtained from spoil monitoring wells in the Battle River area of Alberta. Measurements of temperature, dissolved oxygen, pH, alkalinity, conductivity, turbidity, total iron and sulfide were made in the field. Dissolved oxygen and temperature were measured directly in the wells. The major ion chemistry of the spoil groundwater at both the Diplomat and Vesta Mines is described and histograms of water chemistry are shown. A Piper trilinear plot of spoil groundwater composition is given for each mine and a listing is given of the chemical analyses for the Battle River Bed. A plot of total dissolved solids, sodium and sulfate concentrations versus time is given for each of five wells in the Diplomat spoil. Groundwater samples from spoil at Diplomat Mine and Vesta Mine, in addition to samples from the Battle River Bed, were analysed for the elements antimony, arsenic, boron, cadmium, cobalt, copper, lead, and selenium, as well as for the distribution of iron and sulphide in both spoil and pre-mining groundwater. Trace element concentrations in spoil groundwater are compared to levels in the unmined Battle River Bed as a measure of any changes resulting from the mining process.

064234
TRUDELL MR, MASLOWSKI A, WALLICK EI, MORAN SR * **Assessment of reclamation potential and hydrologic impact of large-scale surface mining of coal in plains areas of Alberta: summary report of activities 1982-83, Appendix I, Prediction of groundwater chemistry in reclaimed landscapes** * 14p * (Alta Res Counc) * 1983-03.

The determination of salt-yielding properties of surface-mine overburden has been undertaken as an approach to predicting the chemistry of groundwater in mine spoil. Saturation extract analyses of overburden samples are limited by mineral saturation constraints. The first leach of an infinite dilution type experiment (10:1 water to sediment) provided the best approximation of spoil groundwater composition, although it produced insufficient sulfate. All of the methods studied overestimated the salinity of spoil groundwater. Salt yields from drift provide the best approximation of spoil groundwater composition, whereas bedrock samples produced too little sulfate, calcium and magnesium. The composition of the spoil groundwater appears to be determined mainly by thin layers of highly saline drift or weathered bedrock, although the salinity of the spoil groundwater depends on the access of water to the salts within the spoil, and on mineral solubility. This works was carried out as part of the Plains Hydrology and Reclamation Project, which is supported by the Alberta Heritage Savings Trust Fund and administered by the Reclamation Research Technical Advisory Committee (RRTAC) of the Alberta Land Conservation and Reclamation Council.

064250
TRUDELL MR, MORAN SR * **Assessment of reclamation potential and hydrologic impact of large-scale surface mining of coal in plains areas of Alberta: summary report of activities 1982-83, Appendix A-1, Spoil hydrogeology and hydrochemistry at the Battle River Site in the plains of Alberta** * 25p * (Alta Res Counc) * 1983-03.

The planned expansion of coal strip mining activities in Alberta has prompted research into the hydrogeology and groundwater chemical evolution of reclaimed lands. In the Battle River area of central Alberta, where coal beds occur in the Upper Cretaceous Horseshoe Canyon Formation, the spoil areas of two mines have been intensely instrumented as part of this research. The cast overburden at the Diplomat Mine is derived from calcareous till; at the Vesta Mine the overburden which forms the spoil is a mixture of sodic shale, siltstone and sandstone. Recharge to the spoil at both mines is occurring by leakage from surface ponds and vertical infiltration through the spoil. At Diplomat Mine lateral inflow from the adjacent unmined coal is also contributing to the resaturation of the spoil. Groundwater flow at Diplomat Mine is controlled by a valley that developed during the mining process, and which is acting as a subsurface drain. At Vesta Mine a groundwater mound has developed in the spoil causing migration of spoil water into adjacent unmined areas. In both settings high water table conditions appear to be directly related to the presence of surface ponds in the reclaimed landscape. The chemical makeup of groundwater in the spoil at both mines is characterized by levels of Na^+, $SO_4^=$ and total dissolved solids that are several times higher than in the unmined coal. In spoil groundwater total dissolved solids concentration up to 12 300 mg/l and $SO_4^=$ concentration up to 8 400 mg/l have been detected. These groundwaters are commonly saturated with respect to gypsum, as calculated by the USGS computer program WATEQ-F. The release of additional soluble and weatherable $SO_4^=$ salts from the cast

overburden under conditions of gypsum saturation will result in gypsum precipitation, thereby limiting the concentration of SO4= in the spoil groundwater. This may act to reduce the magnitude of the peak SO4= concentration attained in the spoil groundwater, and extend the duration of the SO4= pulse when gypsum re-dissolution occurs in later periods.

064238
TRUDELL MR, STERENBERG GJ * **Assessment of reclamation potential and hydrologic impact of large-scale surface mining of coal in plains areas of Alberta: summary report of activities 1982-83, Appendix L, Post-mining water supply at the Battle River Site** * 29p * (Alta Res Counc) * 1983-02.

Surface mining of coal in the Battle River Project Area of Alberta will directly disrupt two principal aquifers, the Battle River Bed and the Paintearth Bed. This report discusses a study of six aquifers in the Battle River Area to determine the potential post-mining water supply. The hydraulic properties of aquifers was determined primarily by single well response testing of piezometers. The transmissivities determined from these tests were then used to arrive at an approximate long-term well yield. Major ion concentration of water samples from piezometers were the basis of evaluation of water quality in the various aquifers. A summary is given of the water quality in domestic wells, as well as a breakdown of domestic wells by stratigraphic unit. The study and comparison of the six aquifers revealed shortcomings in each, however, by utilizing aquifers only in those regions where characteristics are conducive to an adequate water supply, maximum coverage of the area by potential alternate supply aquifers will be achieved.

065218
VONHOF JA * **Hydrogeological and hydrochemical investigation of the waste disposal basin at I.M.C.C. K2 potash plant, Esterhazy, Saskatchewan** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

064233
WALLICK EI * **Assessment of reclamation potential and hydrologic impact of large-scale surface mining of coal in plains areas of Alberta: summary report of activities 1982-83, Appendix H, Gas composition in the unsaturated zone as an index of geochemical equilibrium in reclaimed landscapes** * 13p * (Alta Res Counc) * 1983-03.

This study is based on field work at the Battle River Mine area. The amount of oxygen and carbon dioxide in the gas in the unsaturated zone of reclaimed mine spoil is an indication of the type and level of geochemical activity of the water in the spoil. Potential for oxidation of organic matter and pyrite is indicated by the oxygen content; aggressiveness toward carbonate and silicate minerals is indicated by the carbon dioxide content. As these values approach the values observed in unmined landscapes, the reclaimed landscapes can be considered to have reached geochemical equilibrium.

064564
WALLIS PM * **The uptake of dissolved organic matter in groundwater by stream sediments - a case study** . IN: Perspectives in running water ecology * LOCK MA, WILLIAMS DD * 97-111 * Plenum Publ Corp * 1981.

Dissolved organic matter (DOM) is the most important source of organic energy in headwater streams. Groundwater is the major component of stream flow, and its DOM contributes large amounts of energy to stream production. Nutrient concentration in the stream is higher than in groundwater, so the transition from ground to stream water leads to more favourable conditions for microbial growth and metabolism. Field uptake experiments, and 13C studies, were carried out in the Marmot Basin, in the Kananaskis Valley near Calgary, Alberta. Sediment samples for laboratory experiments were taken from Laurel Creek near the University of Waterloo. The average uptake of groundwater DOM in the Marmot Basin was calculated to be 207 mg per m per h. This high level of uptake suggests that stream bacteria can remove higher portions of the dissolved organic load than groundwater bacteria. The 13C content of streamwaters from the mouth of the Middle Creek Tributary is less than that of the source spring. This suggests that additional organic matter which has not been so efficiently degraded has entered the stream between the two sites. The decrease in concentration of DOM in groundwaters as they percolate into the stream through the sediments indicates that energy is made available to sessile microorganisms from the source. This organic matter is mobilized from the humus layer by infiltrating precipitation and carried through the unsaturated and saturated groundwater zones. Despite the high uptake rates found during field studies, DOM in groundwater must still be considered to be refractory in nature.

064567
WALLIS PM, LADD TI * **Organic biogeochemistry of groundwater at a mountain coal mine** * Geomicrobiol J * 3(1) 49-78 * 1983.

Measurements of dissolved organic matter (DOM), humic and fulvic acids, carbohydrates, tannins + lignins, phenols and amino acids were made in the groundwater permeating Reclamation site 2 at the Canmore Coal Mine (Alberta, Canada). Estimates of the number of bacteria present in the groundwater were also made using plate and direct count techniques.

Temperature, pH, Eh, and oxygen content of the groundwater were measured on two occasions. DOM was very low in concentration (av. 1.62 mg/liter) and consisted principally of fulvic acid. Humic acids formed about 20% of DOM, carbohydrates 6%, tannins + lignins 4%, and trace compounds (phenols, amino acids, and proteins) 2%. Seasonal variations were observed, with tannins + lignins and carbohydrates reaching their highest concentration in the summer, and humic and fulvic acids, and DOM peaking in the winter. The organic composition of the groundwater upstream of the reclamation site did not differ significantly from groundwater sampled from within the reclamation site. Differences were observed, however, between ground and surface waters draining the site. No correlation between concentration and depth was observed. The groundwater bacteria studied appeared to be characterized by slow growth under adverse geological conditions with only low concentrations of labile organic compounds present.

065208
WHITING J, CHRISTIANSEN E, HEUSER H, KERMEEN JS, MAATHUIS H, MACHIBRODA P * **Summary report surface water and groundwater investigations of the Lorado Mill area and meteorology data for the Gunnar uranium tailings** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

064583
ZENON ENVIRON ENTERPRISES LTD * **Environmental review of onshore Canadian oil and gas drilling and production activities** * Econ Tech Rev Rep EPS 3-EP-83-2 * 159p * Environ Can, Environ Prot Serv, Environ Prot Programs Dir * 1983-06.

Current and proposed Canadian onshore oil and gas drilling and production activities are reviewed with respect to their potential for environmental effects. Canadian petroleum geology and related hydrogeology are described to provide a framework for discussion of the impact of oil and gas drilling and recovery operations, including tar sands development, and waste disposal practices. Environmental legislation applicable to oil and gas industry activities is also reviewed. Major environmental concerns identified include the potential for soil and groundwater contamination by drilling fluids, solid wastes, chemical additives, oils and brines, produced sands, and liquid wastes. The potential for contamination depends on handling and disposal practices and the geologic and hydrogeologic characteristics of the drilling and production site. Although fairly comprehensive legislation is in place, its effectiveness in the long-term has not been assessed, and no specific legislation exists for in situ tar sands development. Areas where knowledge is lacking and research is required have been identified.

5.3 Geothermal - Geothermie

066747
JOHN A. LESLIE AND ASSOC LTD, BEDFORD, NS * **Investigation of geothermal energy resources - Nova Scotia and Prince Edward Island** * 120p * Energy Mines and Resour, Earth Physics Branch, 1 Observatory Cres, Ottawa, Ont K1A 0Y3 * 1981.

Data pertinent to the assessment of the geothermal energy resources of Nova Scotia and Prince Edward Island have been compiled and collected. Hot water in both on-shore and off-shore aquifers and hot dry rock within Palaeozoic intrusives are considered as potential geothermal resources and, therefore, constituted the principal study areas. Although there is insufficient data available to delineate specific target areas, there is ample suggestion that geologic environments may exist with as yet indeterminate potential. Further investigations are recommended so that the geothermal energy resources of the region may be fully evaluated.

062531
MIRZA C * **Aquifer thermal energy storage: a look at Canadian R & D in progress** * Can Consult Eng * 25(4) 26-27 * 1983-04.

The use of aquifer thermal energy storage (ATES) technology at Canada Centre, a Government of Canada building in Scarborough, Ontario is described. Using the concept that excess heat or "chill" can be pumped out of or into aquifers without suffering significant losses due to groundwater flows away from the site during the storage period, geotechnical and hydrogeological investigations were carried out to locate an aquifer suitable for ATES technology. Construction of production/injection wells and observation wells, are discussed. The design and use of instrumentation focusing on providing maximum longevity with minimum trouble, is outlined. The use of a computer facility to centrally monitor all the mechanical systems of the project, is reviewed. The selection of this project as the Canadian model for the International Energy Agency of the United Nations, and the future of ATES technology, are discussed.

6. ICE, SNOW, GLACIERS - GLACE, NEIGE, GLACIERS

6.1 Ice - Glace

063113
AAKERMAN J * **Studies on naledi (icings) in West Spitsbergen** , IN: The Roger J.E. Brown Memorial Volume * Proc Fourth Canadian Permafrost Conf, Calgary, Alta, March 2-6, 1981 * FRENCH HM * NRCC 20124 * 189-202 * Assoc Comm Geotech Res, Natl Res Counc Can, Ottawa, Ont K1A OR6 * 1982.

Naledi (icings) have been studied on the west coast of Spitsbergen between 1972 and 1979. The study area contains several naledi of different types which are documented by air photographs taken during the last 50 years. Additional studies based upon field observations and air-photo interpretation have been undertaken in other parts of Spitsbergen. Sixty-three different naledi sites are described, terminology is discussed, and a classification of different types of naledi is proposed. The forms of the naledi related to their genesis, their hydrological characteristics, and their position in the terrain are described. Details of surface morphology, hydrology, salt precipitation, and the naledi as a geomorphological agent are discussed. A study was made to find out if naledi might be used as indicators of short-term climatic variation. Good correlations were found between the length of the freezing period and the ice volume at the end of the winter. It was also found that variations in the summer air temperature can be correlated with either variations in ice volume loss or the remaining surface area of naledi with acceptable accuracy and, that under certain conditions, naledi may be used as indirect indicators of short-term climatic variations.

062417
ADAMS WP * **Spatial variability of snow and ice on lakes and a strategy for measurement based on three years' data from Elizabeth Lake, Labrador** (see chapter 6.2 for complete reference - voir chapitre 6.2 pour la reference complete)

066155
ADAMS WP * **Illustrations of biological roles of winter lake cover** , IN: Proc Thirty-seventh Annual Eastern Snow Conf, June 5-6, 1980, Peterborough, Ont * GOODISON BE * 1-18 * (1980).

The major components of the winter cover of lakes in eastern North America are described within the context of the processes which control their evolution. Examples of the distinctive biological roles of the components and processes are then discussed including their roles in the energy budget, in nutrient loading and in the light and oxygen regimes of the lake. Mention is also made of the ways in which the various components promote or mute the effects of ice-shove on the lake margins.

062414
ADAMS WP, LASENBY DC * **Lake ice growth and conductivity** , IN: Proc of the Western Snow Conf. 50th Annual Meeting, Reno, NV, US, April 19-23, 1982 * 184-185 * (1982).

The vertical variation in the conductivity of water obtained from subsampling ice blocks from Elizabeth Lake, Labrador and Lake St. George in southern Ontario was determined. For the Elizabeth Lake block, conducitivity ranged from 72umhos cm-1 in the white ice to 2umhos cm-1 in the black ice. For the Lake St. George block, conductivity ranged from 78umhos cm-1 in the white ice to undetectable in the black ice. The variations in conductivity are related to the mechanism of ice formation and the structure of the ice blocks.

065056
ADAMS WP, PROWSE TD * **Observations on the use of a mechanical device for measuring the thickness of lake ice** , IN: Proc 37th Eastern Snow Conf, June 5-6, 1980, Peterborough, Ont * 189-192 * (1980).

A device for measuring lake ice thickness is described. The device consists of a sealed metal tube, set in the ice at a time when the ice sheet is still thin, through which passes a rod connected to an arm located in the water beneath the ice. To make a measurement, the tip of the arm is raised to the under-side of the ice sheet and the thickness is then read off the handle of the rod. The device is set so that black ice/white ice interface. It can also be used to measure the thickness of white ice by means of a scale on the side of the tube. A series of measurements, on the circumference of a circle described by the arm, can be made by turning the hand, encompassing local variations in ice thickness. The advantage of greatly speeding up ice measurements so that more than one measurement on a lake can be taken, is emphasized.

066910
ASSEL RA * **Description and analysis of a 20-year (1960-79) digital ice-concentration database for the Great Lakes of North America** , IN: Proc Second Symp on Applied Glaciology, New Hampshire, US, 23-27 August 1982 * Ann Glaciol * v4 14-18 * Cambridge CB2 1ER, GB * 1983.

A digital ice-concentration database spanning 20 years (1960 to 1979) was established for the Great Lakes of North America. Data on ice concentration, i.e. the percentage of a unit surface area of the lake that is ice-covered, were abstracted from over 2,800 historic ice charts produced by United States and Canadian government agencies. The database consists of ice concentrations ranging from zero to 100% in 10% increments for individual grid cells of size 5 x 5 km constituting the surface area of each Great

Lake. The data set for each of the Great Lakes was divided into half-month periods for statistical analysis. Maximum, minimum, median, mode, and average ice-concentrations statistics were calculated for each grid cell and half-month period. A lakewide average value was then calculated for each of the half-month ice-concentration statistics for all grid cells for a given lake. Ice-cover variability and the normal extent and progression of the ice cover is discussed within the context of the lakewide averaged value of the minimum and maximum ice concentrations and the lakewide averaged value of the median ice concentrations, respectively. Differences in ice-cover variability among the five Great Lakes are related to mean lake depth and accumulated freezing degree-days. A Great Lakes ice atlas presenting a series of ice charts which depict the maximum, minimum, and median icecover concentrations for each of the Great Lakes for nine half-monthly periods, starting the last half of December and continuing through the last half of April will be published in 1983 by the National Oceanic and Atmospheric Administration (NOAA). The database will be archived at the National Snow and Ice Data Center of the National Environmental Satellite Data and Information Service (NESDIS) in Boulder, Colorado, USA, also in 1983.

063330
BELTAOS S * **Notes on ice hydraulics** * 43p * Environ Can, Natl Water Res Inst * 1982-11.

In the first part of this report dealing with the hydraulics of covered rivers, a brief review is given of basic concepts of open channel flow, leading to various hydraulic resistance relationships and definitions of the associated coefficients. Extension of these concepts to flow under an ice cover is presented leading to composite hydraulic resistance relationships and coefficients. Values of the latter for different ice cover types are reviewed. A brief discussion of the effects of moving cover on flow depth is included. A qualitative description of ice breakup, jamming and means of alleviation of their effects, is followed by a review of possible procedures to predict potential stages caused by ice jams.

065729
BOLSENGA SJ * **Spectral reflectances of snow and fresh-water ice from 340 through 1 100 nm** (see chapter 6.2 for complete reference - voir chapitre 6.2 pour la reference complete)

F11834
BOSSERT E * **Pour qui sonne le verglas?** (see chapter 3.1 for complete reference - voir chapitre 3.1 pour la reference complete)

063096
BURGESS M, JUDGE A, TAYLOR A, ALLEN V * **Ground temperature studies of permafrost growth at a drained lake site, Mackenzie Delta** . IN: The Roger J.E. Brown Memorial Volume * Proc Fourth Canadian Permafrost Conf, Calgary, Alta, March 2-6, 1981 * FRENCH HM * NRCC 20124 * 3-11 * Assoc Comm Geotech Res, Natl Res Counc Can, Ottawa, Ont K1A OR6 * 1982.

Illisarvik lake on Richards Island, Mackenzie Delta, Canada, was artificially drained in order to investigate the growth of permafrost. Twenty-four boreholes were hydraulically drilled to depths ranging from 15 to 92 m below lake level and were instrumented with temperature cables. Monitoring of ground temperatures beneath the lake and surrounding shore-lines prior to drainage delineated a bow-shaped talik extending up to 32m below lake bottom. Characteristics of the predrainage temperature profiles in the central lake holes were i) an upper unfrozen horizon in which temperatures reached a maximum of 2.5C at roughly 5m below lake bottom, ii) a permafrost table at depths of 20 to 32 m in the central part of the lake with consistently negative temperatures below, and iii) negative temperature gradients below the 5 m maximum temperature, averaging 50 mk/m in the permafrost section. Two years of post-drainage temperature monitoring revealed iv) that the former talik had completely frozen at nearshore sites (10 m thick or less), whereas, v) only 5 to 6 m of new permafrost had formed at central sites, and vi) in the unfrozen sections temperatures were close to OC. A two-dimensional finite element computer simulation of the formation and growth of Illisarvik suggests a minimum lake age of 900 to 1000 years. Post-drainage conditions in the first year after drainage were modelled by studying the microclimatic regime together with the ground thermal regime. Although predicted profiles agreed well with measured temperatures, geotechnical and year-round weather gathering programmes are necessary before further post-drainage modelling is warranted.

066099
CHEE SP, HAGGAG MR * **Critical regime of buoyant blocks** . IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * v2 621-639 * Can Soc Civ Eng * (1981).

In large Canadian rivers, enormous amounts of fragmented ice blocks float downstream during the Winter and Spring breakup and subsequently come into contact with stationary ice masses already in existence in the stream. The moving blocks could become arrested at the leading edge of the ice cover or submerge and cause thickening of the cover depending on the prevailing hydraulic conditions. This paper describes a wide range of instability modes of floating blocks and presents a detailed laboratory investigation of the problem. An

analysis was made of the stability of floating blocks and the mechanics of clock thickening due to underturning and upturning were considered. The effect of the configuration of the upstream edge of the blocks on the instability characteristics was also studied. The influence of the block dimensions such as its length and thickness on its critical regime equilibrium was also investigated. Experimental observations were made in laboratory flumes of 60 in., 18 in., and 6 in. widths, with clear plexiglass walls. Blocks with a wide range of thickness to length ratios and different shapes of upstream edges were utilized in the tests.

066100
CHEUNG JL, GUILLAUD C * **Effects of ice progression during construction of Muskrat Falls hydropower development** , IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * v2 641-661 * Can Soc Civ Eng * (1981).

The Lower Churchill River between Gull Lake and Muskrat Falls remains open for a good part of winter and generates large quantities of frazil ice. The ice accumulates below the future site of the Muskrat Falls Development and gradually forms a huge ice jam by mid-winter. It has been observed in the winters of 1977-78 and 1978-79 that, due to the ice jam, the maximum winter level in the vicinity of the site actually exceeded that of the summer level by as much as 15 m for similar river flows. The severe ice conditions at Muskrat Falls site became the governing factor in determining the height of the downstream cofferdams and has caused a great deal of concern in the planning and design of the river diversion program. In addition to various river diversion schemes, a tunnel scheme which would significantly reduce the upstream ice generation and hence eliminate the ice jamming activities near the site was examined. This paper summarizes the procedures and criteria applied in estimating the maximum winter levels corresponding to the river flows and air temperatures. The process of selecting the diversion scheme is also described briefly.

066101
DANYS JV * **Field measurements of ice forces against cylindrical and conical structures** , IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * v2 682-704 * Can Soc Civ Eng * (1981).

Taking field measurements of ice forces against offshore structures is difficult and expensive. So far only a few have been undertaken to measure ice forces against cylindrical or conical structures. In 1972 Transport Canada installed an automated, remotely controlled system in a conical lightpier at Yamachiche Bend in Lac St Pierre, P.Q. Design problems, various difficulties in operation of this system and obtained readings are discussed in detail and assessed.

F11785
DEWEZ V, LAGAREC D * **La dualite glaciaire-periglaciaire et l'origine de certaines formes dues a la fonte de glace** * Notes de recherches no 34 * 77p * Univ d'Ottawa, Dep de geogr, Ottawa, Ont * 1982.

Depuis plusieurs annees, divers auteurs ont etudie les formes qui resultent de la fonte de glace. La presente etude fait suite et vise a completer les informations jusqu'ici recueillies sur l'origine des differentes formes morphologiques que la fonte de glace a laisse dans l'environnement physique. Les auteurs se propcsent de decrire et critiquer les methodes utilisees par differents auteurs pour repondre a cette question, de voir dans quelle mesure elles permettent d'etablir l'origine la plus probable, et de mettre en evidence l'etroitesse des liens qui unissent les hypotheses emises pour les formes etudiees, les connaissances acquises dans la genese de leurs equivalents actuels et l'etude du pergelisol.

062458
DIONNE JC * **A boulder-strewn tidal flat, north shore of the Gulf of St Lawrence, Quebec** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

066553
DIONNE JC * **Frost-heaved bedrock features: a valuable permafrost indicator** * Geogr Phys Quat * 37(3) 241-251 * Presses de l'Univ de Montreal, PO Box 6128, Stn A, Montreal, Que H3C 3J7 * 1983.

Frost-heaved bedrock features are periglacial forms produced by the vertical displacement of bedrock fragments. Blocks, frost-wedged from bare bedrock along joints, are raised above the general surface by heave. Although mentioned in the literature of the late 19th century, they have been described and studied in detail only recently. They are widespread in the northern hemisphere, notably in Canada, Greenland and Spitsbergen, where they develop in lithologies with well-developed systems of joints. Commonly, heaved blocks exhibit weathered and lichen-covered surfaces except at their base where freshly exposed rock indicates recent heaving. They result from frost processes, particularly from wedging and heaving due to pressure of the freezing of free-water in joints. Active and most non-active features are located in permafrost regions. The southermost occurrence in the northern hemisphere is the Groulx Mountains, in Quebec (51 degrees 45 minutes N, alt. 1000 m). The mean annual air temperature for the area of best-developed features ranges from -4 to -10C, with the number of days of frost ranging from 178 to

300. A thin snow cover is common to most sites. Based on climatic data and on the geographical distribution of frost-heaved bedrock features, it is suggested that permafrost occurrence is obvious. Relict features found outside the present-day permafrost zones should indicate former permafrost conditions.

063146
DOMASCHUK L * **Frost heave forces on embedded structural units** . IN: The Roger J.E. Brown Memorial Volume * Proc Fourth Canadian Permafrost Conf, Calgary, Alta, March 2-6, 1981 * FRENCH HM * NRCC 20124 * 487-496 * Assoc Comm Geotech Res, Natl Res Counc Can, Ottawa, Ont K1A OR6 * 1982.

Large-scale model studies of frost heave forces acting on horizontal, vertical, and inclined members embedded in a silt were carried out under frost penetration rates ranging from about 4 to 75 mm per day. Maximum adfreeze stresses in the range of 150 to 350 kPa under varying rates of frost penetration were measured on steel structural angles embedded vertically in the soil. A limiting value of 350 kPa was attained at a freezing rate of 4 mm per day. Maximum basal heave pressures in the range of 1900 to 2500 kPa were measured on a short steel structural member placed horizontally on the surface of the soil. No limiting value of basal heave pressure was attained under the test conditions used. Limiting resultant vertical pressures ranging from 350 to 1300 kPa were measured on steel structural members embedded at an inclination of 45 degrees. A graph of frost heave pressure versus member inclination was prepared on the basis of the study, which should serve as a guide for the design of structural units embedded in frost-susceptible soils.

062860
EBA ENG CONSULT LTD * **Mackenzie Delta - Beaufort Sea development plan: permafrost response study nearshore & onshore pipeline geothermal analysis** * vp * EBA Eng Consult Ltd * 1981.

This report presents the results of a study of the geothermal interaction between a subsea oil pipeline and surrounding permafrost soil. The pipeline is intended to carry oil from offshore production islands in the Beaufort Sea to a pipeline terminal on Richards Island in the Mackenzie Delta. The pipeline will be operated at a temperature greater than 0 degrees C which will introduce into the design the risk of instability due to thaw of permafrost supporting soils. The study documented in this report is intended to provide a preliminary estimate of the extent of thaw that may occur during the operating lifetime of the buried pipeline for both the shallow water offshore and onshore conditions. All geothermal analyses were conducted using a finite element geothermal simulation model developed at EBA. The model calculates transient heat conduction in soil of variable composition, accounts for latent heat of fusion within the soil, and heat exchange at the ground surface. Ground surface heat exchange is computed from meteorological data such as air temperature, solar radiation, greenhouse factor, wind velocity, snow depth and evapotranspiration.

063152
ESCH DC * **Thawing of permafrost by passive solar means** . IN: The Roger J.E. Brown Memorial Volume * Proc Fourth Canadian Permafrost Conf, Calgary, Alta, March 2-6, 1981 * FRENCH HM * NRCC 20124 * 560-569 * Assoc Comm Geotech Res, Natl Res Counc Can, Ottawa, Ont K1A OR6 * 1982.

By pre-thawing and consolidating the upper layers of the permafrost, a thinner stable roadway embankment may be constructed, provided the thickness of the embankment plus that of the prethawed layers are adequate to contain the full seasonal thaw zone. Six test plots were established near Fairbanks, Alaska, in April 1980, to determine how surface modifications may be used to accelerate thawing of permafrost by increasing the solar heat gain. The various modifications examined included clearing and stripping the surface, construction of a thin gravel pad darkening of the gravel pad surface with asphalt, and the use of clear polyethylene film to create a "greenhouse effect" on both gravel pad and stripped sections. Each section simulated a full roadway width with adjacent uncleared vegetation. Instrumentation used to monitor performance included heat flow meters, windspeed and radiation sensors, and thermocouples for subsurface temperature observations. Thaw depths and surface settlements were recorded monthly at nine points on each section, and monthly measurements of surface albedo were also made for each treatment. Differences between thaw depths achieved with the different treatments have been as much as 40 per cent. Results of this study are used in analyses of probable benefits of roadways and airfields constructed after pre-thawing for one season.

061913
FREDERKING R, SCHWARZ J * **Model tests of ice forces on fixed and oscillating cones** * Cold Reg Sci Technol * 6(1) 61-72 * Elsevier Sci Publ Co Inc, J Inf Cent, 52 Vanderbilt Ave, New York, NY 10017 US * 1982-08.

A series of model tests has been carried out on downward breaking conical structures using low salinity model ice. Comparison with information in the literature showed that a downward breaking cone experiences lower ice forces than an upward breaking cone. Fixed cones of angles of 15, 30, 45 and 60 deg were tested in 50-mm-thick ice of 60 kPa flexural

strength at velocities ranging from 0.01 to 0.5 m/s. The effects of thickness and flexural strength variations were also investigated. Horizontal forces were observed to increase with increasing velocity. Ice thickness variation was observed to have a stronger influence on the vertical forces than on the horizontal forces. Vertical and horizontal forces showed a decrease with decreasing flexura strength. Two test series were run with the 45 deg conical structure arranged so that is oscillated. Horizontal force reductions of up to two thirds were observed.

066911
FREDERKING RMW, TIMCO GW * **On measuring flexural properties of ice using cantilever beams** , IN: Proc Second Symp on Applied Glaciology, New Hampshire, US, 23-27 August 1982 * Ann Glaciol * v4 58-65 * Cambridge CB2 1ER, GB * 1983.

Tests have been performed on fine-grained, columnar, freshwater ice sheets 40 to 70 mm thick grown in a refrigerated model basin. Cantilever beams of various geometries were tested for lengths ranging from 200 to 2,000 mm and widths of 50 to 250 mm. Analysis of the results in terms of simple elastic beam theory indicated that modulus increased with increasing beam length and decreasing beam width. An analytical model for beam deflection was developed, taking into account the effects of buoyancy, shear, and rotation and deflection at the root. This model satisfactorily explained the observed deflection behaviour and the apparent geometry dependence of the modulus. Flexural strength was independent of beam length, but decreased with increasing beam width. Flexural strength was independent of loading rate, whereas modulus decreased with increased loading time.

063095
FRENCH HM (ED) * **The Roger J.E. Brown Memorial Volume, Proceedings of the Fourth Canadian Permafrost Conference, Calgary, Alberta, March 2-6, 1981** * NRCC 20124 * 594p * Assoc Comm Geotech Res, Natl Res Counc Can, Ottawa, Ont K1A OR6 * 1982.

The proceedings include papers relating to the climate and permafrost; permafrost in the Northwest Territories, the Gaspe Peninsula, southwestern Ontario, Manitoba, and Alberta; aspects of permafrost and soils, mainly in the Arctic; hydrology in permafrost regions; geophysics and subsea permafrost; the occurrence, origin or development of gas hydrate deposits; the laboratory testing of frozen soil; engineering applications in permafrost areas.

F11216
FRENCH HM * **Etudes de puisards IV: perturbation du pergelisol adjacent aux puits d'exploration au nord du territoire du Yukon** * Etude environnementale no 19 * 59p * Minist aff indiennes et du Nord Can, Ottawa, Ont * 1982.

Une etude geomorphologique a ete entreprise en juillet 1979 a l'emplacement de cinq puits de petrole et de gaz abandonnes dans la region de la plaine d'Eagle et du plateau de Peel au nord du territoire du Yukon (NTS 106L, 116I, 116H). Les puits suivants ont ete visites: Aquitaine Alder C-33, Chevron SOBC WN N. Parkin D-61, SOBC Blackstone D-77, Mobil Gulf Peel H-71, et Gulf Mobil Caribou N-25. Ces puits ont ete choisis comme representatifs des conditions generales regnant dans la region ou parce qu'ils avaient notamment connu des problemes de terrain et d'elimination des fluides de forage. La principale conclusion a laquelle sont arrives les chercheurs est que les perturbations du terrain a l'emplacement des puits dans le nord du Yukon ne sont pas aussi evidentes que dans certaines parties du delta du Mackenzie et des iles Arctiques. Cela est sans doute attribuable a la vulnerabilite generalement plus faible du terrain dans la majeure partie de l'interieur du territoire du Yukon, ainsi qu'a la rapidite relative de la regeneration vegetale dans ces zones de transition entre la foret boreale et la toundra de buissons.

F11217
FRENCH HM, SMITH MW * **Etudes des bassins a boue II - perturbations geothermiques des terrains pergelisols adjacents aux emplacements de puits de petrole et de gaz** * Etude environnementale no 14 * 61p * Minist aff indiennes et du Nord Can, Ottawa, Ont * 1981.

Deux bassins a boue, l'un a l'emplacement du puits Bent Horn 1-01 de la Panarctic, dans l'ile Cameron, et l'autre a l'emplacement du puits Ogruknang M-31 de la Gulf, dans les monts Caribou, ont ete munis d'instruments durant l'hiver 1976-1977 pour surveiller les conditions geothermiques du pergelisol environnant. Nous nous sommes servis de la simulation numerique etablie d'apres les donnees sur le terrain pour predire les modifications geothermiques. Le forage du puits Bent Horn 1-01 n'a dure qu'un seul hiver; celui du puits Ogruknang M-31 a dure deux saisons hivernales, et le bassin a boue y est demeure beant pendant l'ete pour etre remblaye au cours du second hiver. Au puits 1-01, des donnees eparses revelent que les fluides gelent presque instantanement des leur entree dans le bassin a boue et qu'ils restent geles apres la remise en etat de l'emplacement. Au puits M-31, les fluides n'etaient pas geles completement au moment du remblayage. Dans les deux emplacements, les temperatures du pergelisol sous le bassin se sont beaucoup elevees pendant la periode du forage du puits. Les donnees du puits M-31 revelent a) que les temperatures a une profondeur de 0,5 m sous le fond du bassin a

boue s'elevaient rapidement, passant de -14 a -4C pendant les premiers temps d'utilisation du bassin, pour ensuite s'elever lentement jusqu'a 0,5C a la mi-septembre 1977, b) que le degel du pergelisol a l'ete de 1977 a ete restreint aux parois du bassin, c) qu'a une profondeur de 2,5 m sous le fond du bassin, les perturbations geothermiques deviennent minimes et d) qu'en 1978, les temperatures a une profondeur de 2,0 m sous le fond du bassin avaient presque atteint l'equilibre de -1 a -2C. Ces donnees indiquent que l'utilisation de bassins souterrains pour recueillir les fluides de forage dans les deux localites susmentionnees n'entrainera pas la degradation du pergelisol et qu'ils finiront par geler in situ, meme s'ils ne l'etaient pas completement au moment du remblayage. Ces conclusions ne s'appliquent pas aux regions a pergelisol plus chaud et (ou) a temperatures estivales plus elevees.

063140
FUKUDA M * **Heat flow measurements in freezing soils with various freezing front advancing rates** , IN: The Roger J.E. Brown Memorial Volume * Proc Fourth Canadian Permafrost Conf, Calgary, Alta, March 2-6, 1981 * FRENCH HM * NRCC 20124 * 445-452 * Assoc Comm Geotech Res, Natl Res Counc Can, Ottawa, Ont K1A OR6 * 1982.

Field observations at the Tomakomai Forest experimental station (Hokkaido), during the winters of 1975-1976 and 1976-1977, were undertaken to determine the relationship between the rate of frost heave and the speed of progression of the freezing front, and to measure the associated thermal flux. The poor relationship between the observed and calculated thermal flux values is attributed to insufficient knowledge of soil moisture conditions. Laboratory procedures are described which measures frost heave and soil moisture by the gamma ray attenuation method.

066084
GALBRAITH PW * **On estimating the likelihood of ice jams on the Saint John River using meteorological parameters** , IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * vi 219-237 * Can Soc Civ Eng * (1981).

Ice jams have occasionally been associated with damaging spring floods on the Saint John River in New Brunswick. Although the forecasting of the exact place and time of such ice jams is beyond the present foreseeable capabilities of the flood forecaster, it has been suggested that an estimation of the likelihood of ice jams would be useful to emergency planners, managers of hydro-electric resources and others. In this paper we discuss the formation of ice jams and the role of meteorological parameters in the process. In particular, indices related to basin snowmelt and to basin precipitation during the ice breakup period are examined as possible predictors of ice jam events. The analysis indicates that meteorological indices related to high rates of snowmelt during the breakup period were associated with the years of most significant ice jam events. The rate of accumulation of thawing degree-days appears to be a useful index in predicting the risk of ice jams. The role of precipitation was more ambiguous but was obviously a contributing factor in some events.

063142
GILPIN RR * **A frost heave interface condition for use in numerical modelling** , IN: The Roger J.E. Brown Memorial Volume * Proc Fourth Canadian Permafrost Conf, Calgary, Alta, March 2-6, 1981 * FRENCH HM * NRCC 20124 * 459-465 * Assoc Comm Geotech Res, Natl Res Counc Can, Ottawa, Ont K1A OR6 * 1982.

The object of this study was to develop a condition which, when applied at the interface between frozen and unfrozen soils in a numerical model of the ground thermal regime, would describe the relative rates of frost heave and frost front advance that would occur. The starting point for this calculation was a basic physical model of the frost heave mechanics. The result is in the form of a semi-empirical expression which is fitted to experimental data. This form is similar to some of the other empirical frost heave expressions that have been proposed. It thus provides a physical basis for them and gives some guidance as to their likely ranges of validity.

066912
GOLD LW * **Creep of columnar-grained ice at low stress** , IN: Proc Second Symp on Applied Glaciology, New Hampshire, US, 23-27 August 1982 * Ann Glaciol * v4 * 9 ref, 5 fig, 1 tab * 1983.

An investigation was undertaken of the creep of columnar-grained ice under constant compressive stresses of 98 and 59 kPa in order to extend the observed relationship between strain-rate and stress further into the low-stress region. Stress was applied perpendicular to the long direction of the grains. Observations were made for temperatures between -5 and -40 C. The steady-state creep rate for secondary creep was not yet attained for strain of 1.4% and stress of 98 kPa. An initial yield was observed at that stress in the strain range of 0.2 to 0.3%, similar to that seen at higher stress. The observations showed that the strain-rate tended to a linear dependence on stress below 49 kPa and that more than one dislocation process with different values for the stress exponent may contribute to the strain at higher stresses. An activation energy of 63 kJ per mol was consistent with the observed temperature dependence of the strain-rate. Straining ice to a given strain

under a stress of about 0.3 MPa and then reducing the load may be a convenient way to study the stress, strain and temperature dependence of the strain-rate at low stress.

064549
GOODWIN CR (ED) * **APOA bibliography, Third edition** * ASTIS Occas Publ No 1 * 113p * Arct Inst North Am, Univ Calgary, 2500 University Drive NW, Calgary, Alta T2N 1N4 * 1982-10.

The purpose of the APOA Bibliography is to make other northern researchers more aware of the amount and type of research being conducted by the APOA, and to provide detailed author, subject and geographic access to this research. This third edition of the bibliography contains all APOA-conducted or APOA-funded research reports in the ASTIS database as of October 1982, a total of 359 documents. The bibliography includes only research done by individual member companies. All reports in this bibliography have been released to the public. The bibliography will be updated periodically as additional reports are released.

F11109
GOUV CAN * **Le gouvernement federal achete un Dash-7R pour la reconnaissance des glaces** * 3p * Gouv Can * 1983-10-14.

Charles Caccia, ministre de l'Environnement, a signe avec la societe de Havilland Aviation du Canada Limitee un contrat de 26 millions de dollars pour l'achat d'un avion a grand rayon d'action, le DASH-7 Ranger, entierement equipe pour la reconnaissance des glaces. Transports Canada, dont le ministre responsable est M. Lloyd Axworthy, entrera en possession de l'appareil en juin 1985. Le gouvernement sera en mesure, pour la premiere fois, d'offrir un service de prevision et de reconnaissance des glaces le long de la cote est du Canada. L'avion et les instruments de detection perfectionnes ont ete concus et fabriques au Canada. Le nouveau service permettra de garantir la securite et l'efficacite des operations en mer tout en protegeant l'environnement. Pour plus de renseignements, communiquer avec J.A.W. McCulloch, Dir gen serv centraux, Serv environ atmos, Environ Can, Downsview, Ont.

063098
GRAY JT, BROWN RJE * **The influence of terrain factors on the distribution of permafrost bodies in the Chic-Choc Mountains, Gaspesie, Quebec** , IN: The Roger J.E. Brown Memorial Volume * Proc Fourth Canadian Permafrost Conf, Calgary, Alta, March 2-6, 1981 * FRENCH HM * NRCC 20124 * 23-35 * Assoc Comm Geotech Res, Natl Res Counc Can, Ottawa, Ont K1A OR6 * 1982.

Ground temperature studies revealed the presence of several contemporary bodies of discontinuous permafrost on the windswept treeless summits of the Chic-Choc Mountains in Gaspesie. One such permafrost body on Mont Jacques-Cartier is 45 to 60 m thick and related to a mean annual ground surface temperature of -1 to -1.5C. Snow cover is the principal terrain factor governing the presence or absence of permafrost. Snow depth indices derived from long-term data from a similar climatic region in central Quebec-Labrador permitted the Mont Jacques-Cartier permafrost to be plotted on the basis of snow cover. The rapid increase in snow depth as one crosses from the tundra into the krummholz zone enabled a close correlation to be made between the permafrost boundary and the tree-line and this facilitated regional mapping of permafrost bodies throughout the Chic-Choc Mountains. This correlation is not perfect, however. First, local tree-lines occur below the critical altitude at which the mean annual air temperature is sufficiently low to induce the development of permafrost, either due to local lithologic, microclimatic, or geomorphological conditions. Secondly, in the tundra zone large topographic hollows on the leeward side of summits harbour a deep winter snow pack which inhibits permafrost development. Thirdly, below the regional tree-line, lenses of permafrost occur in rock glaciers at the base of steep slopes. In one case, an ice lens 5 to 10 m thick was observed during excavations at the toe of the rock glacier.

063978
GUIMONT P, LAVERDIERE C * **The exposed bed of La Grande Riviere, Fluvial and ice morphology between LG 1 and LG 2** * 7p * Geos, Energy, Mines Resour, 580 Booth St, Ottawa, Ont K1A OE4 * 1980.

In the fall of 1978, La Grand Riviere temporarily dried up when the by-pass galleries surrounding the LG2 moraine core dam were closed. In October 1979, the water returned to the river bed when part of the hydro-electric power plant was put into service. A detailed description is given of the temporarily exposed river bed. A magnificent glacial contour was evident at the bottom of a valley overdeepened to a trough. Superimposed on this relief, where breaks in slope occur in the rocky basement, are a number of unusual, purely fluvial formations. Features associated with the erosion action of drift ice take the form of remarkable furrows and ridges in the clay bed. Depositional formations occur as vast fields of stones and boulders transported by drift ice and left behind at certain spots. Running water has removed the finer particles from the course debris, which is morainic or fluvio-glacial in origin, or the product of frost shattering. Finally, sand veneer and sand banks have been deposited in sites protected by the water's loss of carrying capacity. The erosion bed and the depositional bed of La Grand Riviere are described.

063141
HANLEY TO, RAD SR * **Electrical freezing potentials and the migration of moisture and ions in freezing soils** , IN: The Roger J.E. Brown Memorial Volume * Proc Fourth Canadian Permafrost Conf, Calgary, Alta, March 2-6, 1981 * FRENCH HM * NRCC 20124 * 453-458 * Assoc Comm Geotech Res, Natl Res Counc Can, Ottawa, Ont K1A OR6 * 1982.

In continuation of work previously reported on freezing potentials, this paper reports voltages measured at a constant freezing rate (interface advancing at 2.8 x 0.0001 cm/s) and amounts of electric charge required to neutralize the displacement of charge produced by freezing, in sludges consisting of silica, kaolin, and bentonite. For the freezing potential, a model is proposed which takes into account the diffusion of cations in the unfrozen portion of the sample, the separation of ions at the freezing front, and the migration of moisture and ions towards the freezing front. Results calculated from this model are compared with experimental values of the potential. In connection with the measurements of electric charge, in the order of 1 to 100 micro Coul., a model is discussed based on the electrical double layer which forms at the surface of a mineral surrounded by water. Further studies should aid understanding of water migration and corrosion in freezing soils.

063101
HARRIS SA * **Identification of permafrost zones using selected permafrost landforms** , IN: The Roger J.E. Brown Memorial Volume * Proc Fourth Canadian Permafrost Conf, Calgary, Alta, March 2-6, 1981 * FRENCH HM * NRCC 20124 * 49-58 * Assoc Comm Geotech Res, Natl Res Counc Can, Ottawa, Ont K1A OR6 * 1982.

This paper examines the possibility of using the distribution of zonal permafrost landforms to aid in mapping permafrost distributions. In areas with under 50 cm snow cover in winter, permafrost zones can be defined by freezing and thawing indices. The relationship works for Norway, Spitzbergen, Canada, and Mongolia. Since these include a wide range of thermalenvironments, it is possible to trace the thermal ranges of various periglacial landforms. The zone of continuous permafrost markedly transgresses mean annual air temperature isotherms and is delimited by areas of Holocene felsenmeer and ice-wedge polygons in mineral soils. Active ice wedges in peats, earth hummocks, and cementery mounds, non-sorted polygons, and open system pingos extend into the zone of discontinuous permafrost. Sorted polygons and closed system pingos extend even further. Palsas, peat plateaux, and ice caves extend from the zone of continuous permafrost into that of sporadic permafrost in Norway and Quebec.

063102
HARRIS SA, BROWN RJE * **Permafrost distribution along the Rocky Mountains in Alberta** , IN: The Roger J.E. Brown Memorial Volume * Proc Fourth Canadian Permafrost Conf, Calgary, Alta, March 2-6, 1981 * FRENCH HM * NRCC 20124 * 59-67 * Assoc Comm Geotech Res, Natl Res Counc Can, Ottawa, Ont K1A OR6 * 1982.

Twenty-eight drill holes ranging from 15 to 150 m in depth have been instrumented with strings of thermistors and thermocouples at six study sites between Plateau Mountain and Jasper, south-west Alberta. Measurements are made every four weeks and indicate that the lower limit of continuous permafrost forms a dome-shape with its centre at Bow Summit, at 2575 m. The limit lies around 2130 m at Jasper and 2270 m at Plateau Mountain. This dome appears to be due to increased snowfall around the ice caps and glaciers, and there may be an inverse relationship between the elevation of the glaciation limit and that of the lower limit of continuous permafrost at a given latitude. In areas of low winter snowfall, the zone of discontinuous permafrost usually extends only 25 m in elevation below the lower limit of continuous permafrost but probably increases in altitudinal range as mean winter snowfall increases. Relict permafrost occurs at Plateau Mountain, which is the only site which shows no signs of overriding by Pleistocene glaciers. Even there, present-day heating and cooling waves extend downwards throughout the layers being studied. It is therefore suggested that the "zone of zero amplitude" be renamed the "zone of minimal amplitude" defined as being where the amplitude over a period of two years is less than 0.20C.

065355
HAYHOE HN, TOPP GC, BAILEY WG * **Measurement of soil water contents and frozen soil depth during a thaw using time-domain reflectometry** (see chapter 5.1 for complete reference - voir chapitre 5.1 pour la reference complete)

064171
HERON R * **The ice cover characteristics of two small lakes in the Peterborough area** , IN: Studies in snow and ice (a collection of student research papers and essays) * ROULET NT * Trent Stud Geogr, vol 8 * 121-132 * Trent Univ Geogr Soc, Trent Univ, Peterborough, Ont * 1980.

The distribution of ice thicknesses on Coon Lake was relatively uniform and comparable to examples cited in the literature. The Little Lake ice cover was strongly influenced by the currents under the ice and a large amount of spatial variability in ice thickness resulted. However, the ice thickness distributions were remarkably similar for the two survey years. This then provides a basis for predicting which areas of the lake ice cover may be unsafe and also permits the one or more ice

monitoring sites to be located for maximum information. However, more research on the effects of river-lake interaction on the winter ice cover is required.

063148
HEUER CE, KRZEWINSKI TG, METZ MC * **Special thermal design to prevent thaw settlement and liquefaction** , IN: The Roger J.E. Brown Memorial Volume * Proc Fourth Canadian Permafrost Conf, Calgary, Alta, March 2-6, 1981 * FRENCH HM * NRCC 20124 * 507-522 * Assoc Comm Geotech Res, Natl Res Counc Can, Ottawa, Ont K1A OR6 * 1982.

During construction of the Trans-Alaska Pipelines System (TAPS), a special thermal design was developed to mitigate thaw settlement and liquefaction concerns along two short, buried segments of the pipeline. The design was implemented as a remedial measure after the pipeline was already in the ground. It included thick pipe insulation, a layer of ground surface insulation, an array of freestanding heat pipes, and groundwater drains. Based on measured soil temperatures, the design has performed well, except that in one of the segments, the thaw upslope of the pipeline is deeper than expected. The thaw poses no significant risk for the pipeline. The design is a good example of the care taken on TAPS to avoid geotechnical problems, and similar designs may find applications on future projects. The paper first describes the geotechnical conditions in the special design areas and how the potentials for thaw settlement and liquefaction were determined. Then the design alternatives considered are very briefly discussed, and the thermal design selected is presented in detail. Finally, soil temperature data are analyzed to evaluate design performance.

066814
HJ PORTER AND ASSOC LTD * **Ice formation study Chocolate Lake** * 36p * HJ Porter Assoc Ltd, Halifax, NS * 1980-02.

The ice on Chocolate Lake, Halifax County, Nova Scotia has shown unusual variations in formation rate, thickness and occurrence. This report investigates these variations during the winter season (1979-1980) and, to a lesser extent 1978-1979. Based on the information assembled in this report, it is concluded that the problem may be traced to a number of causes: 1) a leak from either a main or an old service connection is contributing significant water to the lake from the central water supply; 2) a series of local points of groundwater discharge, and; 3) the direction of the predominant wind during the initial freezing of the lake causing the upwelling water from the above sources to be dissipated yielding the peculiar shape of the area of open water. It is recommended that the sources of main water and groundwater be corrected.

063452
HUDSON RD, METGE M, PILKINGTON GR, MCGONIGAL D, SCHWAB D * **Final report on the field studies and aerial mapping along the north - west edge of the Canadian Archipelago** * vp * 1980.

A three week field study to investigate ice dynamics and ice features along the N.W. edge of the Canadian Arctic Archipelago is described. Fourteen ground sites were visited covering a variety of ice phenomena. More than 2300 line km of aerial photography, yielding over 4000 square km of data, was taken. Floe sizes and ice types from more than 24,000 floes have been analyzed and are presented, giving the best statistical base so far of the Arctic's most dynamic ice zone. Numerous ice failure mechanisms were documented, including ride-up and local crushing within close proximity of each other. A 5 m thick MY sheet was observed to ride up to a height of 23 m on a 26 degree slope. Old landfast ice was noted from central Prince Patrick Island (77 degrees N) extending northwards in increasing thickness to the ice shelves of Axel Heiberg and Ellesmere Islands. This ice had massive ridges running parallel to the edge; these have been designated as multiyear hummock fields (MYHF). Their origin, formation and movements are described. Grounded shear ridges were recorded to water depths of 50 m. Large ice blocks and ice island fragments are documented and described, as well as two cases where ice rubble, behaving like a cohesionless Mohr-Coulomb material, has been extruded in significant amounts. Of particular interest to the group were the driving and crushing stresses in pack ice. Six sites were investigated: the detailed descriptions of their exact locations, the measurements taken and the assumptions made, are described in Appendix I: Site reports.

061867
JEFFRIES M * **The Ward Hunt Ice Shelf, spring 1982** * Arctic * 35(4) 542-544 * 1982-12.

In order to improve the understanding of arctic ice shelf evolution, ice coring and water sampling were undertaken and observations made on the Ward Hunt Ice Shelf and surrounding area during spring 1982. A total of 74 m of 7.6 cm diameter ice core was obtained from seven locations including Ward Hunt Ice Shelf, Ayles Fiord and Milne Ice Shelf. Water sampling of Lake 'A' and Disraeli Fiord indicated that these water bodies remain stratified. Observations of ice conditions between Ward Hunt Island and Cape Evans revealed the following accretion of multi-year ice along the front of Ward Hunt and Milne Ice Shelf; grounding and/or loss of approximately 40 sq km of ice shelf near Cape Discovery; possible development of rolls in multi-year ice Ayles Fiord; and evidence of former ice tongues in Milne Fiord.

F10211
JONES HG, OUELLET M * **Caracteristiques physico-chimiques et microbiologiques de la couverture de glace de quelques lacs** * Eau du Que * 16(2) 174-182 * 1983-05.

Des etudes sur l'evolution des parametres physico-chimiques et microbiologiques de la couverture de glace et des eaux sous-jacentes des lacs Matamek, Piche, Saint-Jean, Nathalie, Gallienne, Tantare ainsi que du lac Mistassini (Quebec) ont permis de reconnaitre certains facteurs influencant les caracteristiques physico-chimiques du manteau hivernal de ces systemes lacustres. Les processus de migration des eaux des zones de sorbet en provenance des eaux atmospheriques sous l'influence des evenements meteorologiques, la translocation des composants chimiques des eaux sous-jacentes de la couverture a travers la glace noire vers la glace blanche donnent lieu a une accumulation d'elements majeurs et de nutriments a l'interface entre la glace noire et la glace blanche. La composition chimique de ces zones reflete a la fois leurs origines et leur dynamique a court terme. Les mesures de la concentration de l'adenosine triphosphate demontrent que ces zones abritent une activite microbiologique dont la nature est presentement inconnue; elle est toutefois probablement microbienne et heterotrophe.

066164
JONES R, ORR DB * **Freeze-out of nutrients from lake ice** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

066914
JONES SJ, CHEW HAM * **Effect of sample and grain size on the compressive strength of ice** , IN: Proc Second Symp on Applied Glaciology, New Hampshire, US, 23-27 August 1982 * Ann Glaciol * v4 129-132 * Cambridge CB2 1ER, GB * 1983.

The effect of sample and grain size on the uniaxial compressive strength of polycrystalline ice has been investigated at -10 C, at a strain-rate of 5.5 x 0.0001 per S. The results show (a) that the sample size must be 12 or more times greater than the grain size for it to have no effect on the strength and (b) that there is no significant dependence of compressive strength on grain size, within the grainsize range of 0.6 to 2.0 mm.

062003
KAMPHUIS JW, MOIR JR * **Ice breakup and jamming observations along the Mackenzie River** * Can J Civ Eng * 10(1) 78-91 * 1983-03.

The breakup of ice along the Mackenzie River between Fort Simpson and Fort Good Hope was studied in 1979, 1980, 1981, and 1982. This paper describes the 1980 and 1981 observations. An aircraft dedicated to this task was used to make over 40 observation flights during those two breakup seasons in which more than 20 major ice jams were observed during their formation, stationary position, and breakup. Although the paper is based on experience gained during only 4 years, it was found that all observed jams displayed the same major characteristics; hence it appears that general descriptions of ice melting, breakup, and jamming for the section of the Mackenzie River under investigation are possible. Although there could be additional variations, these are expected to be minor. The paper describes the ice melting process prior to any ice movement. The ice jamming process as it takes place along the Mackenzie River is discussed as well as the various parameters that affect this process. Several secondary factors that influence the detailed character of the jams are also addressed.

065337
KAY BD, GROENEVELT PH * **Development of a model to describe subsurface transport of solutes as a consequence of freezing conditions, final report** (see chapter 5.2 for complete reference - voir chapitre 5.2 pour la reference complete)

062920
KRISHNAPPAN BG * **Suspended sediment profile for ice-covered flows** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

063135
LADANYI B * **Borehole creep and relaxation tests in ice-rich permafrost** , IN: The Roger J.E. Brown Memorial Volume * Proc Fourth Canadian Permafrost Conf, Calgary, Alta, March 2-6, 1981 * FRENCH HM * NRCC 20124 * 406-415 * Assoc Comm Geotech Res, Natl Res Counc Can, Ottawa, Ont K1A 0R6 * 1982.

The experience gained with the pressuremeter creep tests in the last ten years shows that, because of the equipment limitations, one such test can furnish creep data only for relatively short creep times and for a medium range of stress. Borehole relaxation tests are the alternative to borehole creep tests in the determination of the creep parameters of frozen soils. Their advantage is that the strain is controlled and the stress variation observed, so that there is no danger of exceeding the volume capacity of the cell. Consequently, borehole relaxation tests can easily cover the area of low stresses and can be performed for long periods of time. The question arises, however, whether the creep parameters deduced from creep and relaxation tests, respectively, are equivalent. A field study, carried out recently at a permafrost site near Inuvik, N.W.T., attempted to answer this question and

the principal results of that study are discussed.

063100
LAGAREC D * **Cryogenetic mounds as indicators of permafrost conditions, northern Quebec** , IN: The Roger H.E. Brown Memorial Volume * Proc Fourth Canadian Permafrost Conf, Calgary, Alta, March 2-6, 1981 * FRENCH HM * NRCC 20124 * 43-48 * Assoc Comm Geotech Res, Natl Res Counc Can, Ottawa, Ont K1A OR6 * 1982.

Along the east coast of Hudson Bay, palsas and related cryogenic mounds are easily discernable evidence of the presence of permafrost. Analysis of their distribution shows a zonation oriented NE-SW, approximately parallel to the shore. In the first zone, within 20 km of the shore and mainly north of Richmond Gulf, peat-bogs are scarce and mineral cryogenic mounds occur in most locations where surficial deposits exist. In the second zone, peat-bogs are more widespread and permafrost is found both in surficial deposits (mineral cryogenic mounds) and peat-bogs (palsas). South of 56 degrees N, towards the interior, string-bogs are the dominant type of peat-bogs, with occasional partially collapsed palsas. Permafrost has been more widespread in the region in the recent past, and its extent is now decreasing. In areas of discontinuous permafrost such as that of the study, the distribution of palsas and related cryogenic mounds is a good indicator of the extent and general conditions of permafrost.

F11651
LARIVIERE R * **Amenagement hydraulique et protection de l'environnement** (see chapter 4.5 for complete reference - voir chapitre 4.5 pour la reference complete)

063109
LEWKOWICZ AG, FRENCH HM * **The hydrology of small runnoff plots in an area of continuous permafrost, Banks Island, N.W.T.** , IN: The Roger J.E. Brown Memorial Volume * Proc Fourth Canadian Permafrost Conf, Calgary, Alta, March 2-6, 1981 * FRENCH HM * NRCC 20124 * 151-162 * Assoc Comm Geotech Res, Natl Res Counc Can, Ottawa, Ont K1A OR6 * 1982.

Hydrologic studies of four small runoff plots were conducted in the continuous permafrost zone of north-central Banks Island between 1977 and 1979. One plot was located on an interfluve while the other three were on slopes where snowbanks develop. The plots ranged in size from 27 to 525 sq m. For two to three months of each summer field season, all the major inputs and outputs of the hydrologic cycle were measured at each plot. The results of the study indicate a high degree of variability in the proportions of water losses from the plots, attributable to surface and subsurface flow. This variability is evident both in inter-year comparisons for a single site and inter-site comparisons for a single year. Inter-year variability is controlled largely by the winter snow distribution and by meteorological conditions during the melt season. Inter-site variability is influenced by snowbank size, with the largest snow accumulation site exhibiting the highest percentage loss to surface flow, and the smallest loss to subsurface flow and evapotranspiration. Surface-flow hydrographs of snowmelt runoff recorded at the plots are explicable within the context of accepted snowmelt theory. Surface flow generated by rainfall was much less important and occurred only twice in the three years of measurement. On these occasions, only areas downslope of existing snowbanks, or those areas from which snow had recently disappeared, produced surface flow. These observations support the validity of the partial and variable concepts of runoff generation in the high Arctic. Areas producing surface flow are dependent on topographically controlled snowbank distribution, rather than, as in temperate areas, on the location of streams.

062040
MACKAY JR * **Downward water movement into frozen ground, western arctic coast, Canada** (see chapter 5.1 for complete reference - voir chapitre 5.1 pour la reference complete)

064072
MACKAY JR, MATTHEWS JV * **Pleistocene ice and sand wedges, Hooper Island, Northwest Territories** * Can J Earth Sci * 20(7) 1087-1097 * 1983-07.

Buried ice and sand wedges have been found in glacially deformed sediments that can be no younger than the early Wisconsinan. The environmental conditions at the time of ice-wedge cracking have been inferred from the number of elementary ice veinlets, the vertical extent of the wedges, collapse structures, oxygen isotope ratios, and macrofossils of plants and insects. The winter ground and summer climates were probably as warm or warmer than the present. The preservation of the ice in the ice wedges shows that permafrost has been present at Hooper Island since at least the early Wisconsinan.

064202
MARKHAM WE * **Ice atlas, Canadian arctic waterways** * vp * Minist Supply Serv, Hull, Que K1A OS9 * 1981.

Systematic ice reconnaissance of Arctic waterways began in the early 1950s by the United States and Canada, and has continued for more than twenty years. This atlas is a summary of the comprehensive surveys of ice conditions in the Canadian Arctic. Data collected through aerial ice observations have

been analysed through weekly snapshots of ice conditions. The resulting accumulation of fifteen years of detailed data provides an overall summary which is an aid to shipping, to the resource industries and the planners of northern development.

063111
MICHEL FA, FRITZ P * **Significance of isotope variations in permafrost waters at Illisarvik, N.W.T.** , IN: The Roger J.E. Brown Memorial Volume * Proc Fourth Canadian Permafrost Conf, Calgay, Alta, March 2-6, 1981 * FRENCH HM * NRCC 20124 * 173-181 * Assoc Comm Geotech Res, Natl Res Counc Can, Ottawa, Ont K1A 0R6 * 1982.

Analyses for 18O and 2H contents in permafrost cores from the Mackenzie River basin revealed very large depletions in the heavy isotope contents with depth. These shifts could be a reflection of decaying climatic conditions resulting in lower 18O and 2H contents in older ice or, under special circumstances, might be due to isotope fractionation processes occurring during freezing. Thus, as part of a detailed study of permafrost growth at the drained lake site known as Illisarvik on Richards Island in the Mackenzie Delta, a number of continuous cores were collected from within, and adjacent to, the lake bed. Water extracted from the samples by squeezing was analyzed for 18O, 2H, and 3H isotopic contents in addition to conductivity. The soils were examined for grain size and moisture content, while organic-rich horizons were dated using the radiocarbon method. Radiocarbon dating of the lake-bed sediments indicate that the lake initially formed some 6700 to 8700 years ago. The 18O contents from the Illisarvik lake bed are in the range of -15 to -16 per mille near the surface, which are similar to the average lake water prior to drainage. Outside of the lake, 18O contents vary from -14 to -31 per mille. Tritium is confined to the active layer outside of the lake, while within the lake bed tritium occurs to a depth of 2 m. The results of this and other ongoing studies into the distribution of stable and radioactive isotopes occurring naturally in waters related to permafrost indicate that such investigations provide valuable insight into the history and origin of these waters.

063105
MORGAN AV * **Distribution and probably age of relict permafrost features in south-western Ontario** , IN: The Roger J.E. Brown Memorial Volume * Proc Fourth Canadian Permafrost Conf, Calgary, Alta, March 2-6, 1981 * FRENCH HM * NRCC 20124 * 91-100 * Assoc Comm Geotech Res, Natl Res Counc Can, Ottawa, Ont K1A 0R6 * 1982.

Over three hundred areas of polygonal ground principally developed upon the Tavistock Till, deposited by the Huron ice lobe, and the Port Stanley Till, deposited by the Ontario-Erie ice lobes, have been located in south-western Ontario. The polygons are believed to be the surface expression of either former ice-wedges, or sand-wedges. These were formed in the period from about 15,000 to 13,000 years B.P. and may involve more than one period of activity. Fossil insect faunas from Michigan and New York indicate that a climatic regime compatible with the existence of permafrost was present at 13,800 years B.P., but that it had disappeared prior to 12,700 years B.P. The periglacial zone in which the polygons were created was probably localized and may have existed elsewhere, at later dates, in positions where the morphology of the retreating Laurentide ice was favourable.

062239
MURPHY TJ, SCHINSKY AW * **Net atmospheric inputs of PCBs to the ice cover on Lake Huron** * J Great Lakes Res * 9(1) 92-96 * 1983.

This report describes the first measurements of the net atmospheric deposition of PCBs to the ice cover of a body of water. The net deposition of PCBs includes the wet, dry, and vapor deposition, less any evaporation. The measurements were made on ice cores collected from the frozen surface of Lake Huron late in the ice seasons of 1978 and 1979. Intrusions of lake water into the accumulated deposition layer of ice and snow were not encountered in these studies. Such intrusions, however, have complicated other attempts to use this method. Possible reasons for not encountering them in this study are discussed. For Saginaw Bay, a net deposition rate of 2.0 gm per sq km per mo of PCBs to the ice was found for the winters of 1977-1978 and 1978-1979. Upon ice break-up and thaw in the spring, all of the PCBs accumulated on the ice are likely to enter the bay. For inner Saginaw Bay, this would have been 8 kg in March 1978 and 6.5 kg in March 1979.

066045
NEWBURY RW, MCCULLOUGH GK * **Shoreline erosion and restabilization in a permafrost-affected impoundment** (see chapter 7.2 for complete reference - voir chapitre 7.2 pour la reference complete)

063143
NIXON JF, ELLWOOD JR, SLUSARCHUK WA * **In situ frost heave testing using cold plates** , IN: The Roger J.E. Brown Memorial Volume * Proc Fourth Canadian Permafrost Conf, Calgary, Alta, March 2-6, 1981 * FRENCH HM * NRCC 20124 * 466-474 * Assoc Comm Geotech Res, Natl Res Counc Can, Ottawa, Ont K1A 0R6 * 1982.

The concept is introduced of a circular cold plate as a device for determining the frost heave characteristics or susceptibility of soils in situ. The advantages include (1)

the ability to test the in situ, undisturbed soil and groundwater conditions, not subjected to possible sampling disturbance, and (ii) the ability to test a much larger volume of soil than is possible in standard laboratory tests. A parallel might be drawn with the use of the plate bearing test in conjunction with standard laboratory compression tests in determining the stress-strain characteristics of soils in conventional geotechnical practice. The design, fabrication, installation, and instrumentation of several 0.76 m diameter cold plates are described. Instrumentation includes heave measurement rods, thermistors, and earth pressure cells. These plates have been sucessfully installed and operated in the south Yukon and Calgary. Results from these tests provide a bridging between small-scale laboratory testing and eventual frost heave design for larger diameter, buried, chilled gas pipelines. Results from one of two cold plate installations at the pipeline research facility in Calgary are presented in detail, and brief comparisons are made with the behaviour of full-size pipeline test sections. The in situ cold plate test provides valuable test data within a few months that are a valuable aid to long-term frost heave predictions.

062908
NIXON JF, MORGENSTERN NR, REESOR SN * **Frost heave - pipeline interaction using continuum mechanics** * Can Geotech J * 20(2) 251-261 * 1983-05.

As a chilled pipeline crosses a transition from frozen to unfrozen ground or shallow permafrost, a differential frost heave problem may develop causing strains in the pipe. Soil-structure interaction models that are currently available to handle this problem concentrate on the pipe as the dominant structural member and represent the soil mass as a series of unconnected springs. This paper considers the soil to be an elastic or nonlinear viscous continuum and imposes a nonlinear boundary condition to represent the frost heaving soil and the dependence of frost heave on applied pressure. The pipe is assumed to be a completely passive structural member and the soil strains at the pipe elevations are studied. The dependence of the maximum pipe strains on the length of the heaving section and on the thickness of frozen ground beneath the pipe have been established for a typical set of soil and frost heaving conditions. It is found that, for the conditions studied, when the thickness of shallow permafrost or frozen soil is greater than about 7-8 m, the strains that a flexible pipe experiences are less than the strain criteria currently in use on many pipeline projects.

062573
NYGAARD E * **Permafrost, Arctic underpinnings** * Sci Dimension * 14(5/6) 8,10,12,14 * 1982.

Geotechnical engineers from the Civil Engineering Department at the University of Alberta have been involved in studies related to the design and construction of oil and gas pipelines in the north. Soil samples were taken from numerous locations, reconstituted in the laboratory and tested for thaw-strain behavior under various temperature and drainage conditions. Results were compared with theoretical expectations and gradually a mathematical model was developed. In 1973 the model was tested with a 27 m experimental pipeline buried in permafrost at Inuvik, N.W.T. Engineers went on to study thaw-consolidation theory as it relates to landslides, particularly where the permafrost exists in fine-grained terrain. A site near Fort Norman was selected for field studies related to creep in frozen ground. Researchers discovered that the more ice in a zone, the greater its creep or movement. As a result of these studies, the researchers have been able to develop state-of-the-art pile designs for buildings and they contend that their findings also can be applied to tunnelling in frozen ground. Engineers have also been studying the problems encountered when unfrozen ground freezes. Geotechnical engineers must decide how to calculate the amount of frost heave likely to occur over the lifetime of the pipeline project and to what extent heave will vary along the pipeline. Researchers are still looking into the properties of permafrost in saline soils, the implications of thawing around offshore wells, and the mechanical behavior of ice.

065743
ONT MINIST NAT RESOUR * **Ice management manual** * 23p * Ont Minist Nat Resour * (1982-11).

In 1980 an ice jam program was initiated by the Conservation Authorities and Water Management Branch in Ontario. The objective of the program was to prepare a manual that would contain guidelines and procedures for monitoring, predicting and acting on ice break-up and jamming on rivers in Ontario. Projects were started with the Grand River, Ganaraska Region and Credit Valley Conservation Authorities for the purposes of identifying factors affecting ice jams and collecting data such as ice cover, air temperature and streamflow data. In addition, special investigations on specific ice jam problem areas in northern Ontario were carried out. This program also reviewed and documented the history of ice jam problems and remedial measures in the province. In November 1982 the manual was published and it provides the preliminary information and guidelines which can be used to determine the proper procedures for predicting, preventing and dealing with ice-related flooding.

064170
PRICE J * **A comparative study of ice regimes during the freeze-up period on the Indian River, near Peterborough, Ontario** , IN: Studies in snow and ice (a collection of student research papers and essays) * ROULET NT * Trent Stud Geogr, vol 8 * 110-120 * Trent Univ Geogr Soc, Trent Univ, Peterborough, Ont * 1980.

The process of river ice formation is discussed in a geographical context. A comparative study is made between locations of diverse hydrographic character in order to highlight the situation response to specific hydrometeorological variables. The varied ice regimes produced above and below a small concrete dam are explicitly discussed and the generalizations formed are extended to a number of similar study locations including several local dimictic lakes.

062295
RHINESS J * **$652 M price tag tied to Norman Wells pipeline facilities** * Can Pet * 24(2) 28-29,31,33 * 1983-03.

Esso Resources Canada Limited plans to increase production from its Norman Wells oilfield in the Northwest Territories. New expansion facilities will include the drilling of 150 new wells for producing oil and injecting water, six artificial islands, a submarine/on-land gathering system, and a central processing facility. An 869 km pipeline is to be constructed from Norman Wells to Zama, Alberta by Interprovincial Pipe Line (NW) Ltd. to ship the crude and condensates. The expansion project presents unique challenges because of the reservoir location under the Mackenzie River, the harsh winter climate and the remote location. Pipeline completion is slated for July 1985. The buried oil pipeline was the subject of an innovative computer stress analysis ultimately designed to generate cost effective engineering solutions. Evaluations on the crude oil pipeline included frost heave, thaw settlement and pipe denting. Stresstech Engineering Ltd. of Calgary developed the SAVFEM (Structural Analysis Via Finite Element Methodology) Program. The program has a pipeline analysis pre-processor to reduce data input common to many standard pipeline stress analysis problems. It has extensive post processor capabilities including interactive graphical displays of deformed or stressed shapes, time/load history and contour plots. In addition, it has stress/strain checking and ordering, load case combinations and other features.

064176
ROULET NT (ED) * **Studies in snow and ice (a collection of student research papers and essays)** (see chapter 6.2 for complete reference - voir chapitre 6.2 pour la reference complete)

064172
ROULET NT, WOLFE BR * **The relationship between a lake ice and snowcover and zooplankton distribution** , IN: Studies in snow and ice (a collection of student research papers and essays) * ROULET NT * Trent Stud Geogr, vol 8 * 133-148 * Trent Univ Geogr Soc, Trent Univ, Peterborough, Ont * 1980.

The penetration of surface incident radiation through varying types of winter lake cover and the response of several species of zooplankton were examined. Snow and white ice were found to be significant in the attenuation of light. Black ice showed much less of an influence. Several species of zooplankton were affected by the variation in transmitted light caused by various cover types. There was a marked increase in total numbers in the black ice situation. Individual species response is discussed.

064169
RUSSELL B * **Cover development on Elizabeth Lake, Labrador, with special reference to black ice** , IN: Studies in snow and ice (a collection of student research papers and essays) * ROULET NT * Trent Stud Geogr, vol 8 * 100-109 * Trent Univ Geogr Soc, Trent Univ, Peterborough, Ont * 1980.

The development of a snowcover, white ice, black ice, and total ice of Elizabeth Lake is discussed. This development is compared to that of the cover of nearby Knob Lake. Factors affecting the evolution of a lake cover are discussed. The inter-relationship between snowcover, white ice, and black ice, with particular reference to thermal regimes, receives attention.

063121
SARTORELLI AN, FRENCH RB * **Electro-magnetic induction methods for mapping permafrost along northern pipeline corridors** , IN: The Roger J.E. Brown Memorial Volume * Proc Fourth Canadian Permafrost Conf, Calgary, Alta, March 2-6, 1981 * FRENCH HM * NRCC 20124 * 283-295 * Assoc Comm Geotech Res, Natl Res Counc Can, Ottawa, Ont K1A OR6 * 1982.

Electro-magnetic induction methods have been used to map permafrost over more than 1000 km of northern gas-pipeline corridors over the past five years. The soil conductivity data obtained is integrated with other geological and geotechnical information in order to 1) identify optimal borehole locations, 2) map extent of permafrost degradation in areas of cultural disturbance, and 3) map lateral and vertical extent of permafrost between boreholes. Electro-magnetic induction instruments induce an electric current in the ground. The magnitude of the induced current depends on the conductivity of the soil. Soil conductivities can often be ten times higher for unfrozen ground than for frozen ground. Several inversion techniques are used to establish the

conductivities of the different frozen and unfrozen soil strata. The more useful methods use borehole information and the "geometric factor" approach. When integrated with borehole and other site-specific geological and geotechnical information, the conductivity data has provided much valuable information on the lateral and vertical extent of frozen soil along the pipeline corridor.

F11819
SEGUIN MK, ALLARD M * **La repartition du pergelisol dans la region du detroit de Manitounuk, cote est de la mer d'Hudson, Canada** * J can sci terre * 21(3) 354-364 * 1984-03.

Quarante-quatre sondages de resistivite electrique ont ete realises sur les cuestas des iles Manitounuk (55 degrees 30'N sur la rive est de la mer d'Hudson) et dans les depots meubles marins de la zone supra-littorale de la rive est du detroit de Manitounuk. Le pergelisol est present dans les basaltes et les quartzites proterozoiques des cuestas et peut atteindre une epaisseur d'une trentaine de metres. Le gel permanent a ete decele a partir d'altitudes superieures a 20 m et son absence aux niveaux inferieurs est attribuee a l'effet thermique de la mer, voire a l'infiltration d'eau salee dans les plans structuraux. Les sites pergelisoles sont des etendues au couvert nival pratiquement nul parce que balayes par le vent. Ils sont caracterises la plupart du temps par une morphologie de surface riche en buttes rocheuses periglaciaires et en soulevements de quartiers de rocs. Le pergelisol est reparti en ilots tres disperses dans les basses terrasses meubles et les formes qui lui sont liees sont en voie de degradation. Le gel annuel, conditionne par les variations locales d'epaisseur de la neige, la glace d'estran, l'hydrogeologie et l'effet thermique des marees, est responsable de nombreuses manifestations geomorphologiques: thufurs et buttes cryogenes, soulevements de blocs, dykes clastiques, volcans de boue et autres.

F12170
SEGUIN MK, ALLARD M * **Le pergelisol et les processus thermokarstiques de la region de la riviere Nastapoca, Nouveau-Quebec** * Geogr phys quaternaire * 38(1) 11-25 * Les Presses de l'Univ Montreal * 1984.

L'embouchure de la riviere Nastapoca, sur la cote est de la mer d'Hudson, est situee dans la zone de pergelisol discontinu, en domaine de toundra arbustive. La morphologie cryogene y varie selon les types de depots quaternaires dans lesquels le pergelisol s'est installe. Les limons argileux de la mer de Tyrrell se caracterisent par des champs de buttes cryogenes entrecoupees de mares de thermokarst et de vallons dissymetriques. Parseme d'ostioles et anime de mouvements de solifluxion et de glissements superficiels, le mollisol evolue de facon tres dynamique. La densite croissante des lacs thermokarstiques et une taille decroissante des buttes cryogenes du littoral vers l'interieur des terres illustrent un gradient regional de degradation du pergelisol. Les sables fluviomarins et littoraux pergelisoles constituent aussi des buttes cryogenes, mais sans sols figures. Quant aux drumlins et autres depots de moraine de fond, ils sont affectes par un reseau de polygones a coins sableux. L'epaisseur moyenne du pergelisol dans les depots, mesuree par des sondages de resistivite electrique, est de l'ordre de 20 m. La nivation, la solifluxion, les glissements de terrain et l'effet thermique des mares sont les agents d'une degradation generalisee du pergelisol dans la region.

063099
SEPPAELAE M * **An experimental study of the formation of palsas** , IN: The Roger J.E. Brown Memorial Volume * Proc Fourth Canadian Permafrost Conf, Calgary, Alta, March 2-6, 1981 * FRENCH HM * NRCC 20124 * 36-42 * Assoc Comm Geotech Res, Natl Res Counc Can, Ottawa, Ont K1A OR6 * 1982.

A hypothesis of palsa formation has been tested experimentally in the field in northern Finland. Snow layers were deliberately removed from a peat bog surface several times during three winters. This caused the seasonally frozen layer to almost double in thickness below the surface of the experimental square, and part of this frost then survived through the summer. The cyclic development of palsas is discussed and a process of palsa formation exemplified. It was shown that the thickness of the snowcover is the main factor controlling palsa formation in subarctic conditions.

065786
SHEN HT, YAPA PNDD * **Simulating growth, decay, and break-up of the St Lawrence River ice cover** , IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * v2 807-824 * Can Soc Civ Eng * (1983).

In this paper, a degree-day method for simulating the thermal growth, decay, and break-up of river ice covers is developed and applied to ice covers in the St. Lawrence River between Lake Ontario and Cornwall, Ontario. In the simulation model, the variation of the ice cover thickness is related to the ambient air temperature by the formula: h squared = h squared sub omicron + alpha S - beta t sup theta in which, h = ice cover thickness; h sub omicron = initial ice cover thickness; S = degree-days of freezing since the initiation of the ice cover; t = number of days since the formation of the initial ice cover, and alpha, beta, theta = empirical constants.

064422
SINHA NK * **Creep model of ice for monotonically increasing stress** * Cold Reg Sci Technol * 8(1) 25-33 * Elsevier, New York, NY US * 1983-08.

A numerical integration method of predicting the strain path corresponding to a given stress history, and hence the stress-strain relation, has been developed for polycrystalline materials like ice at high homologous termperatures. The method is based on a generalized creep equation incorporating the grain size effect and predicts strain in terms of elastic, delayed-elastic, and viscous or permanent strains. The theory has been tested successfully during strength tests of ice in the temperature range of -5 to -30C. The monotonous increase in strain rate observed during testing under conditions of constant cross-head displacement rate can now be explained analytically.

063112
SLAUGHTER CW * **Occurrence and recurrence of aufeis in an upland taiga catchment** , IN: The Roger J.E. Brown Memorial Volume * Proc Fourth Canadian Permafrost Conf, Calgary, Alta, March 2-6, 1981 * FRENCH HM * NRCC 20124 * 182-188 * Assoc Comm Geotech Res, Natl Res Counc Can, Ottawa, Ont K1A OR6 * 1982.

As a stream freezes, streamflow is impeded by thickening of the surface ice and accumulation of frazil and bottom ice on channel sides and floor. As flow is restricted, unfrozen water is subjected to increasing hydraulic pressure; this may be relieved by release of water to the surface through cracks in the ice cover or through zones of weakness at stream borders. Water released at the ice surface rapidly loses heat as it flows over the existing ice cover, and subsequently freezes. Recurring episodes of water release and freezing can result in major ice accumulation in, and adjacent to, stream channels. Water held in storage as aufeis may comprise up to 40 per cent of total winter streamflow in an upland subarctic catchment. Aufeis was observed during 1969-80 in a subarctic drainage basin (lat. 65 degrees N). Volume of aufeis accumulation was determined at selected locations. Spring ablation and melt were monitored at several sites over two periods of spring break-up. At one downstream site, aufeis occurred annually for at least seven years; occurrence of aufeis was intermittent during the same years at two upstream locations. Ice volume at the downstream site varied from year to year, but distribution over local areas was relatively consistent. Exposure of the site and the contributing catchment affects aufeis persistance; a south-facing, first-order basin has been consistently ice-free several weeks earlier than a nearby north-facing, first-order catchment.

065358
SMITH DG, REYNOLDS DM * **Tree scars to determine the frequency and stage of high magnitude river ice drives and jams, Red Deer, Alberta** * Can Water Resour J * 8(3) 77-94 * 1983.

An indirect method of using tree scars to determine stage and frequency of ice drives and jams was tested on the Red Deer River at Red Deer, Alberta. The method involves determining the ages and heights of ice scars on river bank tree trunks. Cores, wedges, and slice cross-sections of scarred trunks were sampled to determine scar ages. Heights of the scars above the river surface were also measured. Often scars on a single tree were overlapped and/or located at different heights on the trunk, thus recording multiple ice drive events. The height and age record of ice scarred trees were then compared against the hydrometric and historical record of ice drives and jams. The comparison suggests that by applying a correction factor the indirect method of using tree scars to assess frequency and stage of ice drives and jams is reliable, and shows considerable promise. The method is particularly applicable to rivers which are ungauged or are without a long term hydrometric record.

062910
STEER P, WOO MK * **Measurement of slope runoff in a permafrost region** (see chapter 4.1 for complete reference - voir chapitre 4.1 pour la reference complete)

063097
TAYLOR A, BROWN RJE, PILON J, JUDGE AS * **Permafrost and the shallow thermal regime at Alert, N.W.T.** , IN: The Roger J.E. Brown Memorial Volume * Proc Fourth Canadian Permafrost Conf, Calgary, Alta, March 2-6, 1981 * FRENCH HM * NRCC 20124 * 12-22 * Assoc Comm Geotech Res, Natl Res Counc Can, Ottawa, Ont K1A OR6 * 1982.

In 1978, a shallow permafrost and terrain analysis study was started at Canadian Forces Station Alert, N.W.T. Five holes, drilled to depths down to 60 m, were instrumented with multi-thermistor cables, and temperature measurements have been taken every two or three weeks for the last three years by DND personnel. The drilling sites were chosen to cover various terrain types accessible from the Alert station. Preliminary air-photo analysis indicates that the principal landforms are of glacial and marine origin. A 60 m temperature cable (site 1), installed within 100 m of a shore-line emerging due to glacial unloading, yields temperatures 4 to 5 K warmer than two similar cables installed on inland plateau sites (sites 2 and 3). An analysis of these three sites suggests the higher subsurface temperatures at the shore site result as much from its proximity to the sea as from the period of submergence prior to

3000 years ago. Temperature cables installed in two 15 m holes (sites 4 and 5) on gentle north-and south-facing slopes have shown that aspect has little influence on temperatures at this extreme latitude.

066922
TIMCO GW * **Uniaxial and plane-strain compressive strength of model ice** , IN: Proc Second Symp on Applied Glaciology, New Hampshire, US, 23-27 August 1982 * Ann Glaciol * v4 289-293 * Cambridge CB2 1ER, GB * 1983.

In order to interpret reliably the results of model tests which involve compressive (crushing) failures, the compressive strength of the model ice must be known. In this paper, the uniaxial and plane-strain compressive strengths of carbamide (urea) model ice are documented for scale factors of 40 more than lambda more than 5. In addition, the influences of stress and strain-rates, platen materials and direction of loading are discussed. The results of the tests are interpreted in terms of the structure of the ice.

061914
TIMCO GW, FREDERKING RMW * **Comparative strengths of fresh water ice** * Cold Reg Sci Technol * 6(1) 21-27 * Elsevier Sci Publ Co Inc, New York, NY 10017 US * 1982-08.

In order to gain a quantitative comparison among the various mechanical properties of ice, a series of tests was performed on fresh water ice in which several of the mechanical properties were tested under identical experimental conditions. In particular, the tests were standardized with respect to ice growth conditions, ice type, grain size and orientation, sample size, test temperature and strain rate. The average results of the test were: flexural strength - cantilever beam = 770 plus or minus 150 kPa; flexural strength - simple beam (top tension) = 2200 plus or minus 320 kPa; flexural strength - simple beam (bottom tension) = 1770 plus or minus 190 kPa; fracture toughness = 83 plus or minus 7 kPa; m sup (1/2); shear strength = 500 plus or minus kPa; compressive strength (horizontal loading) = 4400 plus or minus 700 kPa and strain modulus - cantilever beam = 1.6 plus or minus 0.4 GPa. Since most of the tests were performed using a portable compression test machine, the strength values can serve as baseline values for comparison with field results.

062456
TRENHAILE AS, RUDAKAS PA * **Freeze-thaw and shore platform development in Gaspe, Quebec** (see chapter 4.10 for complete reference - voir chapitre 4.10 pour la reference complete)

066863
TSANG G, PEDROSA M * **Development and calibration of the NWRI frazil instrument** * NWRI Unpubl Manuscr No 83-16 * 29p * Environ Can, Natl Water Res Inst, Inland Waters Dir * 1983-10.

After 10 years of development, a frazil instrument capable of measuring the point concentration of frazil in flowing water has been produced and calibrated. The instrument is based on the theoretical principle that when ice is formed, impurities are rejected, frazil therefore may be considered as electrically non-conductive and its concentration in water can be measured by comparing the resistance of a sample of frazil-laden water with that of a sample of frazil-free water. The instrument was calibrated in the laboratory. The calibration testing showed that the instrument performed satisfactorily. Because the frazil crystals are not isotropic, a calibration factor F greater than unity is involved. The division of the measured concentration by F gives the true concentration of frazil in water. F is a function of the flow velocity and turbulence and can be obtained through calibration.

063114
VAN EVERDINGEN RO * **Management of groundwater discharge for the solution of icing problems in the Yukon** (see chapter 5.1 for complete reference - voir chapitre 5.1 pour la reference complete)

F11522
VAN VLIET-LANOE B * **Structures et microstructures associees a la formation de glace de segregation: leurs consequences** , IN: The Roger J.E. Brown Memorial Volume * Comptes rendus de la quatrieme conf canadienne sur le pergelisol, Calgary, Alta, 2-6 mars 1981 * FRENCH HM * 116-122 * Com assoc rech geotech et Cons natl rech du Can, Ottawa, Ont * 1982.

L'etude micromorphologique des structures creees par le gel et plus particulierement par la glace de segregation permet d'identifier le processus periglaciaire responsable de leur formation. Dans le cas le plus simple ou la glace de segregation agit seule, les agregats sont polyedriques subangulaires et lisses par la glace. Apres fusion de celle-ci, les pores separant les agregats forment un reseau discontinu de fentes. Sous l'action repetee d'un gel-degel profond, l'agregat est petit a petit erode a sa base et dote progressivement d'une coiffe constituee de silts et argiles. Sa forme devient lenticulaire. Sur pentes faibles, la microstructure observee est tres voisine de celle caracterisant le gel-degel. Si les pentes s'accentuent ou si le mouvement s'accelere, la gelifluxion apparait et les agregats s'arrondissent completement par rotation. La gelifluxion doit etre consideree comme une cryoreptation acceleree. La structure granulaire de cryoturbation resulte

du debit du sediment par un reseau irregulier d'aiguilles et de lames de glace de segregation.

066161
WOLFE BR * **The role of the lake winter cover in the phosphorus budget of a southern Ontario lake** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

066862
WONG J, BELTAOS S * **Ice freeze-up and breakup observations in the Upper Grand River: 1980-81 and 1981-82 observations** * NWRI Unpubl Manuscr No 84-2 * 24p * Environ Can, Natl Water Res Inst, Inland Waters Dir * 1983-05.

The first two years' ice observations on the Upper Grand River are described and interpreted. Flooding was experienced during both the 1980-81 and 1981-82 breakup seasons and was caused by major ice jams. Breakup initiation data for the Marsville and Upper Belwood gauge sites are consistent with earlier findings on other rivers. This was not the case for West Montrose. A possible cause of this discrepancy is the local formation and behaviour of slush jams during freeze up. Potential peak breakup stages, as predicted by the theory of equilibrium floating jams, were not exceeded by any of the four major jams that were documented. This is in agreement with expectation since three of these jams did not attain equilibrium and the fourth appeared to be associated with overestimated flow discharge.

065799
WONG J, BELTAOS S, KRISHNAPPAN BG * **Laboratory tests on ice jam dynamics** * Natl Water Res Inst unpublished manuscr #83-13 * 29p * Environ Can, Natl Water Res Inst, Inland Waters Dir * 1983-04.

Two series of laboratory tests were conducted in order to study dynamic aspects of river ice jams. The tests investigated (a) the unsteady flow conditions after the release of an ice jam; and (b) the seepage flow conditions through a simulated grounded jam. The first series of tests revealed that the presence of the moving ice has no discernible effect on the characteristics of the surge that follows the release of the jam; and that the model of Beltaos and Krishnappan (1982) gives good predictions of the water levels and fair predictions of the ice speeds. Results of the seepage tests indicated that non-laminar seepage predominates; and that the resulting relationship between the local flow and the upstream and downstream water depths may be applied to both steady and unsteady flow conditions.

063502
WOO MK, STEER P * **Slope hydrology as influenced by thawing of the active layer, Resolute, N.W.T.** * Can J Earth Sci * 20(6) 978-986 * 1983-06.

High arctic slopes have a shallow active layer that thaws unevenly during summer. The result is often a lack of agreement between the configuration of the frost table and the surface topography, and this has effects on the slope hydrology. (1) Areas with a shallow frost table favour surface runoff but areas with a deeper frost table require a thick zone of saturation to generate surface flow. Uneven thaw depths then cause alternating seepage and re-emergence of water down a slope. (2) The configuration of the frost table is highly dynamic, causing day to day changes in water storage capacity in the active layer. (3) A frost table with local depressions can pond up groundwater, which may be rapidly released when part of the frozen sill is breached by continual thawing. (4) The topographical drainage divide may not correspond with the subsurface drainage divide as defined by the frost table, thus allowing groundwater to drain laterally across topographical boundaries. These findings show that a knowledge of the frost table behaviour, both spatially and temporally, is essential to the study of slope hydrology in continuous permafrost terrains.

061856
WOO MK, STEER P * **Occurence of surface flow on arctic slopes, southwestern Cornwallis Island** (see chapter 4.1 for complete reference - voir chapitre 4.1 pour la reference complete)

063137
YOUSSEF H, KUHLEMEYER R, FRENCH R * **Development of an apparatus for static and dynamic creep testing of ice and frozen soils** , IN: The Roger J.E. Brown Memorial Volume * Proc Fourth Canadian Permafrost Conf, Calgary, Alta, March 2-6, 1981 * FRENCH HM * NRCC 20124 * 429-432 * Assoc Comm Geotech Res, Natl Res Counc Can, Ottawa, Ont K1A OR6 * 1982.

The development and construction of an apparatus to be used in experimental studies of the effect of vibratory loads on the static creep rate of ice and frozen soils is described. The apparatus is designed for testing two specimens simultaneously, the first under static axial stress and the second under combined stresses. The combined stresses to which the second specimen is subjected consist of static axial stress identical to that of the first specimen and also dynamic shear stress due to sinusoidal torisional vibration applied at the base of the specimen. Both specimens are subjected to identical temperature conditions. Preliminary tests indicated that the apparatus is capable of testing the static and dynamic creep of ice and frozen soils. The cooling capacity of the

apparatus is -9C; the static loading capacity is 3.60 kN. The range of the vibration frequency is from 0 to 1000Hz.

6.2 Snow - Neige

062417
ADAMS WP * **Spatial variability of snow and ice on lakes and a strategy for measurement based on three years' data from Elizabeth Lake, Labrador** , IN: Proc of the Western Snow Conf, 50th Annual Meeting, Reno, NV, US, April 19-23, 1982 * 49-62 * (1982).

Three sets of data, representing the late February snow, white ice and black ice cover of Elizabeth Lake, Labrador, are analysed and compared. Similar spatial patterns are found to exist between years with central and marginal locations tending to exhibit consistently above or below average thicknesses. It is suggested that the data sets provide a useful basis for designing ice and snow surveys on all medium sized lakes in snowy environments.

065057
ADAMS WP, GLEW JR, OUTERBRIDGE KC, STRICKLAND NA * **Evolution of snowcover at pasture and bush sites, an illustration of techniques** * Ecol Bull * 5(2) 6-11 * Trent Univ, Dep Biol, Peterborough, Ont * 1981.

The potential of the time profile approach as a means of collecting, interpreting and storing snowcover information which can be used for environmental purposes, is illustrated. Two sets of data collected during the winter of 1980 - 1981 at two sites, are presented, one from a pasture, the other from a cedar bush. A "time profile site" is a location at which a series of adjacent pits are dug during a winter so that the evolution of identifiable layers can be followed. Snow time profile diagrams of snow stratigraphy plotted along a time axis, are presented. Similarities and differences between the two sites, similarities resulting from the two snowcovers being influenced by basically the same meteorological events and differences derived from the different topographic locations and vegetation covers in which they are situated, are described. It is concluded that it is possible to collect and store information of snow stratigraphy which is meaningful for a variety of purposes.

065107
ADAMS WP, LASENBY DC * **Lake ice and snow in southern Ontario with particular reference to oxygen regimes - final report to Water Resources Research Support Program** * 5p * 1982-12.

This is a report on work conducted during the period 1977 - 1982 in the following areas: spatial patterns of snow and of various other types of ice on lakes in temperature locations with comparative work in subarctic locations and a 3-year synthesis of the peak winter cover of Elizabeth Lake, Labrador; Lake light regime involving detailed examination of the quantity and spectral quality of light beneath a well developed, multi-layer winter cover; development of techniques and procedures for determing the total water present in the pre-melt snowpack of a lake basin; the involvement of snow and other ice actually on the lakes in lake - atmosphere interactions; conductivity of ice and snow on lakes and in the sub-ice water columns using conductivity as an easily measurable indicator of the concentration of major ions in the various layers of winter lake cover; study of oxygen in lakes including an examination of the mechanisms which contribute to the loss of oxygen in winter under ice especially in Lake St George, Coon Lake, Big Cedar Lake, and Jack Lake, in southern Ontario, and the development of a model used to predict oxygen concentration under ice cover in winter; and detailed work in Jack Lake where spatial and temporal variation in the factors contributing to oxygen loss, are examined.

062545
ADAMS WP, ROULET NT * **Areal differentiation of land and lake snowcover in a small sub-arctic drainage basin** * Nord Hydrol * 13(3) 139-156 * 1982.

A large, stratified, random sample is used to identify vegetation related patterns of snowcover and patterns of land and lake snowcover properties in the basin of Elizabeth Lake, Labrador, Canada. Spatial patterns of snow depth, density and water equivalent are discussed using analyses of variance and trend surface analyses. Statistically significant relationships are demonstrated between these properties and four distinctive "landscape units." Tundra, Open Lichen Woodland, Close Lichen Woodland and Lake. Special features of a mid-winter lake snowcover are discussed including the amount and type of snow present and the spatial patterns in it. The survey system and appears to be useful for hydrologic work.

064328
BARICA J, GIBSON J, HOWARD W * **Feasibility of snow clearing to improve dissolved oxygen conditions in a winterkill lake** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

065738
BEAUDRY P, GOLDING DL * **Snowmelt during rain on snow in coastal British Columbia** , IN: Proc Western Snow Conf, Vancouver, WA, US, 19-21 Apr 1983, 51st Annu Meet * 55-66 * Western Snow Conf, c/o Robert T Davis, PO Box 14884, Spokane, WA 99214 US * (1983).

The objectives of this study are: to compare the energy and water balances of a melting snowpack in a forested and in a clearcut site during rain-on-snow; and to determine the usefulness of the USACE (United States Army Corps of Engineers) snowmelt equations during such events. The study was carried out on Jamieson Creek Watershed in the Seymour River basin near Vancouver. Three approaches were used to determine snowmelt rates: the energy balance; a water balance using snow lysimeters and precipitation data; and a weekly snow survey. The energy balance over a melting snowpack in a 16-ha clearcut was determined with the USACE point source melt equations for 3 rain-on-snow events during the winter of 1983. The results compared favorably with snow survey and lysimeter data. However, use of the equations was deemed infeasible for a second site in an oldgrowth hemlock forest because of the variability of precipitation under the canopy and the absence of wind. Runoff rates during rain-on-snow events were generally less from the forest than from the open, though the difference could not be assessed quantitatively. Further research should include replication of forest plots to account for the variability of wind, net radiation, and precipitation intensity under the canopy.

065729
BOLSENGA SJ * **Spectral reflectances of snow and fresh-water ice from 340 through 1 100 nm** * J Glaciol * 29(102) 296-305 * 1983.

Measured spectral reflectances of new and moderately metamorphosed snow were generally greater than 80% from 340-950 nm. From 950-1 100 nm a characteristic dip and rise of spectral reflectances occurred. One spectroradiometer scan over a deteriorated snow patch showed much lower spectral reflectances than fresh snow, but the shape of the curve remained similar to that of fresher snow. Spectral reflectances for clear ice contrasted sharply with those for snow. In general, values were less than 10% and the curves lacked distinctive shape. Higher spectral reflectances, due to "lighter" appearing ice in the measurement area, were measured at some sites. Refrozen slush, pancake, brash, and slush curd ice revealed spectral reflectance curves similar in form to each other, but which varied significantly in the range of spectral reflectances for each ice type. Generally, reflectances rose slowly from 340 nm to a peak near 550 nm. From 550-775 nm reflectances decreased slowly but significantly. A slight dip and rise in reflectances occured from 775-850 nm after which values again dipped significantly (850-900 nm). From 950-1 100 nm, a dip and rise in reflectances similar to that for snow was observed. The amount of slush included seems to control the reflectances of these ice types. All measurements were acquired with a pair of scanning spectroradiometers having picowatt accuracy, adapted to obtain, automatically, simultaneous readings of incident and reflected radiation from 340-1 100 nm. The spectroradiometers were field-calibrated using Sun-plus-sky radiation as a calibration source.

062469
BRITISH COLUMBIA MINIST ENVIRON, SURF WATER SECT, WATER MANAGE BRANCH * **Snow survey bulletin** * British Columbia Minist Environ, Surf Water Sect, Water Manage Branch *.

The greatest proportion of British Columbia's major river streamflow originates from the melting of mountain snow. Winter precipitation accumulates as snow on the Province's mountainous watersheds, forming Nature's near-perfect reservoir, from which water is released to swell our streams during the spring and summer months. Measurement of the water contained in the snowpack, just prior to the commencement of melt, is a good indicator of subsequent streamflow, which in turn is of great benefit to those concerned with hydro-electric power, flood control, irrigation, and domestic and municipal water supply. Snow courses are established at selected locations and elevations on major and tributary drainage basins. At each measuring point (generally 10 points per snow course) a sampling tube is used to cut through the full snow depth; the depth is noted and the core is weighed. The average core weight indicates the water equivalent of the snowpack. Snow-pressure pillows are being used to obtain a continous record of water equivalent. Pillows in use in British Columbia are methanol-water filled, 3-metre diameter, nylon-reinforced rubber containers. A recording device is attached to the pillow to measure the pressure exerted on the ground by the snowpack. After water-equivalent measurements have been taken at the same sampling date for a number of years, a correlation is derived for a watershed by relating water equivalents and other applicable data to the subsequent streamflow. This relationship is used to forecast seasonal volume streamflow. These streamflow forecasts are published in the April 1 and May 1 bulletins and are made with the assumption that precipitation and temperature patterns will be normal during the forecast period. The daily temperature pattern during the snowmelt period is the critical factor in determining maximum stages on major rivers. Only the very unusual combination of delayed snowmelt, followed by a sustained period of high temperatures, causes flood-producing stages on major rivers. As a public service, the Water Management Branch publishes six issues of the Snow Survey Bulletin each year, February 1, March 1, April 1, May 1, May 15, and June 1. Snow Survey Bulletins are available to the public on request.

065739
CARROLL TR, GLYNN JE, GOODISON BE * **A comparison of U.S. and Canadian airborne gamma radiation snow water equivalent measurements** , IN: Proc Western Snow Conf, Vancouver, WA, US, 19-21 Apr 1983, 51st Annu Meet * 27-37 * Western Snow Conf, c/o Robert T Davis, PO Box 14884, Spokane, WA 99214 US * (1983).

In November 1980, Canadian and American participants developed a project aimed at mapping snow cover over land using passive microwave. The 3-level sampling scheme uses ground-based, airborne, and satellite data collection to assess the snow water equivalent measurement problem over the prairies. One objective of the experiment was to compare US and Canadian airborne gamma radiation snow water equivalent measurements. The airborne snow water equivalent measurements made by the National Weather Service (NWS) and Geological Survey of Canada (GSC) systems agree more closely with each other than with the ground observations. The overestimate the ground data, as might be expected, because of ice layers on the ground, sampling design, ice lens development within the pack, snow sampling equipment, and observer technique. During the week of February 15, 1982, NWS and GSC made airborne gamma radiation snow water equivalent measurements on a network of 43 flight lines in central Saskatchewan. The independent airborne measurements made by different systems agree more closely with each other than either does with the ground measurements. This relationship was also observed in data collected over a network of 12 calibration flight lines in the Lake Superior basin. Ground observations of true snow cover appear to be systematically underestimated.

066159
CHOUDHURY BJ, CHANG ATC * **Incident flux and snowcover albedo for partially cloudy skies** , IN: Proc Thirty-seventh Annual Eastern Snow Conf, June 5-6, 1980, Peterborough, Ont * GOODISON BE * 76-90 * (1980).

The albedo of snow for different cloudiness conditions is an important parameter in the Earth's radiation budget analysis and in the study of snowpack thermal conditions. An efficient method is presented for approximate calculation of incident spectral solar flux and snowcover albedo in terms of atmospheric, cloud, and snow parameters. The model is illustrated using representative parameters for the Antartic coastal regions. The albedo for a clear sky depends inversely on the solar elevation. At high elevations the albedo depends primarily upon the grain size; at low elevations this dependence is on grain size and shape. The gradient of the albedo-elevation curve increases as the grains get larger and faceted. The albedo for a dense overcast is slightly higher than the clear sky albedo at high elevations. A simple relation between the grain size and the overcase albedo is obtained. For a set of grain size and shape, the albedo matrices (the albedo as a function of solar elevation and fractional cloudcover) are tabulated.

062418
DAUGHARTY DA, DICKSON RBB * **Snow cover distribution in forested and deforested landscapes in New Brunswick, Canada** , IN: Proc of the Western Snow Conf, 50th Annual Meeting, Reno, NV, US, April 19-23, 1982 * 10-19 * (1982).

Snow cover distribution in two small (391 ha and 660 ha) forested watersheds in central New Brunswick, Canada was measured for an eight-year period prior to removal of 94% of the forest cover from the smaller watershed in 1978-79. Three years of subsequent measurements are analysed to determine comparisons between the forested and deforested condition. Basin-wide snow cover was not significantly altered prior to the time of maximum snow depth. This is attributed partly to the removal of interception losses from the softwood cover which predominated at lower elevations, and partly to increased drifting which tends to favour redistribution toward lower elevations.

065114
DICKISON RBB, DAUGHARTY DA * **The effects of snowmelt runoff of the removal of forest cover** (see chapter 8 for complete reference - voir chapitre 8 pour la reference complete)

062415
FARNES PE, PETERSON NR, GOODISON BE, RICHARDS RP * **Metrication of manual snow sampling equipment** , IN: Proc of the Western Snow Conf, 50th Annual Meeting, Reno, NV, US, April 19-23, 1982 * 120-132 * (1982).

After four years of field testing, the Western Snow Conference Metrication Committee is presenting its proposal and design of two metric snow samplers. The WSC snow sampler for the deeper western snowpacks has 10.6 cm2 cutter area while the ESC-30 sampler for shallow snowpacks (up to 1 m depth) has 30 cm2 cutter area. The proposal is based on extensive field tests to compare ground truth with the standard Federal snow sampler, the proposed metric snow samplers, and other snow samplers. The committee developed drawings and specifications for the new metric snow samplers. The committee also proposes a method for converting the present standard Federal sampler into a metric sampler.

066102
FOK ATK, MCNEELY DK, PERKS AR * **A hydrotechnical study of a river snow disposal facility** , IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * v2 727-740 * Can Soc Civ Eng * (1981).

A study of ruban snow disposal into the Ottawa River was conducted by McNeely Engineering Limited and Proctor & Redfern Limited. The feasibility of a proposed snow dumping structure was investigated from a hydrotechnical and general environmental point of view. Due to a relatively rapid and deep flow of water past the proposed site, it was found that the formation of frazil ice and ice jamming was unlikely to occur. In comparison with the environmental impacts of alternative disposal methods, the proposed structure would create only local and short-term effects.

062411
FOSTER J, ORMSBY J, RANGO A * **Northern Hemisphere snow cover conditions during the winter of 1982** , IN: Proc of the Western Snow Conf, 50th Annual Meeting, Reno, NV, US, April 19-23, 1982 * 208-211 * (1982).

During the winter of 1982 (December - February) the mean snow covered area in North America was the third greatest in the 16 year record (1966 - 1982). In Eurasia the snow covered area was near normal. But the snow covered area in both North America and Eurasia increased significantly over that of the previous year. Assessment of any long term climatic trends must wait extension of the snow cover data base.

063493
GARDNER JS * **Observations on erosion by wet snow avalanches, Mount Rae area, Alberta, Canada** (see chapter 7.2 for complete reference - voir chapitre 7.2 pour la reference complete)

066154
GOODISON BE (ED) * **Proceedings of the Thirty-seventh Annual Eastern Snow Conference, June 5 and 6, 1980, Peterborough, Ontario** * 224p * (1980).

Papers presented at this conference describe recent studies related to snow and/or ice in the eastern areas of North America. Contents include: Illustrations of biological roles of winter lake cover; Evaluation of the spatial and temporal distributions of snowpack parameters in the Saint John River Basin; Distributions of extreme snowfall in West Virginia; Seasonal streamflow estimation using snow data; Snow accumulation on and around solar collectors; Snow sampling bias in the boreal forest; Incident flux and snowcover albedo for partially cloudy skies; Station experimentale de Duchesnay: rapport de fonctionnement pour l'hiver 1978-79; Operating the Androscoggin River/Reservoir system; Wind tunnel modelling of snow fences and natural snow fence controls; Lake Champlain ice formation and ice free dates and predictions from meteorological indicators; Modelling of shortwave radiation for snow covered terrain; A net shortwave radiation model for glacierized basins; The role of the lake winter cover in the phosphorus budget of a southern Ontario lake; Heat sink capacity of a snow dump site; The influence of snow on the input and movement of cations within a small watershed; Use of a computer mapping package in displaying areal representations of a snowcover; Observations on the use of a mechanical device for measuring the thickness of lake ice; Freeze-out of nutrients from lake ice; AES Nipher shields for recording precipitation gauges; and New 2 and 3 inch diameter CRREL snow samplers. A report of the Eastern Snow Conference Research Committee consists of a list of studies in progress and a selected bibliography for 1980.

062412
GOODISON BE, METCALFE JR * **Canadian snow gauge experiment, recent results** , IN: Proc of the Western Snow Conf, 50th Annual Meeting, Reno, NV, US, April 19-23, 1982 * 192-195 * (1982).

For several years the Hydrometeorology Division of the Atmospheric Environment Service has been conducting field tests on the accuracy and performance of various types of snow gauge installations used throughout Canada. This paper reviews results on the performance of two types of shielding for recording gauges - the Wyoming shield and a large Nipher-type shield now under test by the AES. The advantages and disadvantages of each type of shield are reviewed. Seasonal totals show that on the average the large Nipher-type shield undercatches the standard MSC Nipher snow gauge by less than 10%, while the Wyoming shielded gauge undercatches it by about 25%. Alter-shielded recording gauges generally measure about 60% of the snow-fall measured using the MSC Nipher shielded snow gauge. Inconsistencies in the daily measurements from some recording gauges were observed and these must be understood before the gauges can be operated successfully at automatic stations in Canada.

066158
GRANBERG HB * **Snow sampling bias in the boreal forest** , IN: Proc Thirty-seventh Annual Eastern Snow Conf, June 5-6, 1980, Peterborough, Ont * GOODISON BE * 66-75 * (1980).

Three different sampling bias, common in sampling of the snowpacks of the Boreal forest, are investigated. "Lazy sampling," or avoidance by the observer of sampling beneath tree canopies may cause overestimates of about 10 per cent. "Selective sampling," when the observer selects openings between trees where the snow cover is smooth and even, can cause overestimates of approximately 15 per cent. Snow courses located in "cleared strips" in the forest may overestimate the snowpack water equivalent by 16 - 17 per cent or more. The paper represents a detailed examination of the spatial variations in snow depth, density and

water equivalent in a piece of subarctic woodland.

065164
GREEN JE * **Interim report on small mammal populations and related tree damage in the AOSERP study area, October and November 1977** * 38p * Alta Environ, 15th Floor, Oxbridge Place, 9820-106 St, Edmonton, Alta T5K 2J6 * 1978-07.

The afforestation program in the Athabasca Oil Sands area has been only moderately successful, because of the high mortality of the planted seedlings--much of which is believed to be the result of high levels of small mammal damage. The objectives of the present study were: (1) to determine the species composition and densities of small mammals and the levels of small mammal damage to saplings in revegetation research areas, in naturally revegetating areas, and in woodland habitats and (2) to determine whether the species composition and density of small mammals on the revegetation plots differed between untreated plots and those treated with a rodenticide. Two three-day small mammal trapping periods were conducted on each woodland study area. Surveys of the species composition and density of ground cover and saplings, and of the levels of small mammal damage to saplings were completed on both woodland study areas. The results of the small mammal trapping program and the survey of small mammal damage to saplings are presented. Based on the results of this study and those of a literature review of the methods of control of both small mammal populations and the damage that they cause, a program of research is proposed. The program is to assess the effectiveness of several control methods (habitat manipulation, supplementary food supplies, and repellents) in lowering the levels of small mammal damage to seedlings planted on the reclamation areas of the AOSERP study area.

061974
GRIFFIN HD * **Air quality, Northwestern Ontario, Annual report 1981** * 58p * Ont Minist Environ * 1982-08.

This report presents results of the air quality assessment program in northwestern Ontario for 1981. It includes data from nine communities - Atikokan, Balmertown, Dryden, Fort Frances, Kenora, Marathon, Red Rock, Terrace Bay, and Thunder Bay - in the region where long term monitoring surveys were active during the year, plus summaries of special investigations in the Thunder Bay area. This program measures the levels of air pollutants that may adversely affect human health, animal life, vegetation, and the use and enjoyment of property. Contaminants routinely monitored are described including particulate matter and gaseous pollutants (sulphur dioxide, total reduced sulphur, ozone, and fluoride). The presence and effects of various pollutants are also assessed by documenting vegetation injury symptoms and by determining contaminant concentrations in vegetation, soil and snow. Arsenic, chloride, fluoride, sulphur and heavy metals are typical contaminants examined.

065808
HANSON DG * **Annual snow survey report, Lake of the Woods and Lac Seul watersheds** * vp * Environ Can, Environ Conserv Serv, Inland Waters Dir, West North Reg, Winnipeg, Man * 1983-03.

066157
HARRIS JR * **Snow accumulation on and around solar collectors** . IN: Proc Thirty-seventh Annual Eastern Snow Conf, June 5-6, 1980, Peterborough, Ont * GOODISON BE * 54-65 * (1980).

Studies of the accumulation of snow and ice on buildings with flat plate solar collectors were carried out during the winter of 1979. Although the studies were generally qualitative, preliminary guidelines for snow load criteria were developed. Observations identified two significant phenomena: the sliding of snow from collector surfaces and the drifting of snow around protruding collectors. It was found that only those collectors which are relatively steep (more than 50 degrees from the horizontal) and are free of obstructions will shed snow reliably. The accumulation of snow sliding from collectors appears to be a significant load for roof structures. It was also found that collectors that protrude from roofs tend to create drifts, much as a snow fence. The common installation of several parallel rows of protruding collectors creates a situation somewhat like a "sawtooth" factory building roof and requires special attention in design of the roof structure. Further study of the problem is merited.

066860
JEFFRIES DS, SEMKIN RG * **Changes in snowpack, stream, and lake chemistry during snowmelt in the Turkey Lakes watershed** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

063951
JONES KH * **A comparison of various snow gauges on the Canadian prairies for the winter 1982-83** * 15p * Sci Serv Regina, Airport Terminal Build, PO Box 4080, Regina, Sask S4P 3W5 * 1983-07.

Measurements of snowfall water equivalent were recorded by five gauges located in Regina, Saskatchewan for the winter of 1982-83. Four types of shields were used on the gauges for field tests. The scaled-up version of the MSC Nipher shield on the

Fischer and Porter recording gauge and the standard MSC Nipher gauge showed superior catch efficiency compared to the Wyoming-shielded Belfort weighing gauge and the Alter-shielded standpipe and Sacramento storage gauges. The larger Nipher shield scaled to fit a recording gauge obtained measurements comparable to the official AES Nipher shielded snow gauge.

063783
JORDAN P * **Meltwater movement in a deep snowpack, 2. Simulation model** * Water Resour Res * 19(4) 979-985 * 1983-08.

A numerical simulation model is developed describing the one-dimensional flow of meltwater in a snowpack, based on established methods of modeling unsaturated groundwater flow. The results of field observations of snowmelt and meltwater flow are used to determine parameters describing the hydraulic properties of the snowpack, and surface energy balance measurements are used as input to the model. Tests of the performance of the model show a high sensitivity to the saturated hydraulic conductivity of the snowpack and to liquid water content of the snow. Saturated hydraulic conductivity can be measured with acceptable precision by simple field methods; however, measurement of liquid water content is more difficult and constitutes the major limitation affecting calibration of the model. The model is relatively insensitive to exponents in the power law equations relating conductivity, capillary pressure, and liquid water content. Meltwater wave speeds predicted by the model are somewhat slower than those observed in the field. Observations of snowpack layering and horizontal inhomogeneity of flow suggest that these features affect transient storage of meltwater and consequently cause meltwater wave speeds to differ from those predicted by a one-dimensional model.

063782
JORDAN P * **Meltwater movement in a deep snowpack, 1. Field observations** * Water Resour Res * 19(4)971-978 * 1983-08.

The flow of meltwater through a snowpack can be described by Darcy's law, and by a set of equations relating conductivity, capillary pressure, and liquid water content which are similar to the equations governing unsaturated groundwater flow. Field observations were conducted which were designed to test the applicability of the unsaturated flow equations to the description of meltwater movement at the scale of a small watershed. Simple instrumentation was used to measure capillary pressure and meltwater flux rates; this was supplemented with energy and water balance measurements for the study watershed. Observations of surface snowmelt, meltwater flux, and streamflow for the snowmelt period confirm the nature of meltwater flow as described by the unsaturated flow equations, and illustrate the controlling influence of snowpack hydraulics on the streamflow hydrograph. Observed speeds of the meltwater wave front in the snowpack average about 0.22 m per h, and capillary pressures and kinematic wave speeds observed are comparable to those reported in other deep-snow environments. The difficulty of obtaining reliable liquid water content measurements is identified as a major limitation in the determination of hydraulic properties of the snowpack.

066559
KUKLA G, HECHT A, WIESNET D (ED) * **Snow watch 1980, Proceedings of the workshop, 1-2 October, 1980, Washington, DC** * Glaciol Data Rep GD-11 * 148p * World Data Centre A for Glaciology (Snow and Ice), Coop Inst Res Environ Sci, Univ Colorado, Boulder, CO 80309 US * 1981-10.

This publication reports the results of a workshop sponsored by the National Science Foundation, Washington, D.C. to review the status of data on large-scale snow cover extent and depth. The new information presented is a new departure for publications in the Glaciological Data series. It is divided into the recommendations by workshop attendees, a mailing list of attendees, the role of snow in modeling and climate analysis, the content and accuracy of snow and ice cover charts, and finally, a discussion of the digital products and indices related to snow and ice.

F12172
LAURIOL B, CHAMPOUX A, GRAY JT * **Repartition estivale des surfaces enneigees en Ungava, Nouveau-Quebec** * Geogr phys quaternaire * 38(1) 37-47 * Les Presses de l'Univ Montreal * 1984.

Les caracteristiques spatio-temporelles de la neige en ete, en Ungava, ont ete etudiees par photo-interpretation. Les photographies analysees ont ete extraites de lignes de vol choisies en fonction de leur date et de leur localisation ou selon un echantillonage effectue d'apres la grille de reference des cartes topographiques a 1/50 000 du Canada. Sur les photographies, on a calcule la superficie couverte par la neige ou le nombre de plaques de neige. Les resultats indiquent que les surfaces enneigees varient d'un ete a l'autre, selon l'importance des chutes de neige survenue l'hiver precedent. Les hivers les plus neigeux ont des temperatures un peu moins froides et des flux atmospheriques du nord-est plus importants. En ete, le residu nival le plus important se situe au sud des cotes du detroit d'Hudson. Le residu nival disparait progressivement, entre les mois de juin et d'aout, du sud-ouest vers le nord-est de l'Ungava. Actuellement, la surface occupee par la neige en ete semble plus importante que pendant les annees 1950, du moins le long de

la cote ouest de la baie d'Ungava. En periode d'englaciation, la cote sud du detroit d'Hudson pourrait etre un lieu favorable a la naissance d'une calotte glaciaire.

064167
MCCASKELL PC * **The development of snowcover on a lake in the vicinity of Peterborough, Ontario** . IN: Studies in snow and ice (a collection of student research papers and essays) * ROULET NT * Trent Stud Geogr, vol 8 * 71-88 * Trent Univ Geogr Soc, Trent Univ, Peterborough, Ont * 1980.

An examination of the development of a lake snow cover. A large random sample is used to obtain a whole lake sample, while several stratigraphy pits are used to make lake to land comparisons. Various processes affecting the evolution of the lake cover are discussed, including deflation, redistribution, and constructive and destructive metamorphism. Reference is made to interrelationships between the snowcover and the development of white ice on the lake.

065730
MCCLUNG DM * **Derivation of Voellmy's maximum speed and run-out estimates from a centre-of-mass model** * J Glaciol * 29(102) 350-352 * 1983.

The commonly used maximum speed and run-out equations for flowing avalanches given by Voellmy's (1955) method are considered from a more general model proposed by Perla and others, (1980). Equations analogous to those of Voellmy are derived and the approximations are defined from the point of view of the more general model.

065740
MEIMAN J (CHAIRMAN) * **Proceedings of the Western Snow Conference, Vancouver, Washington, April 19-21, 1983, fifty-first annual meeting** * 160p * Western Snow Conf, c/o Robert T Davis, PO Box 14884, Spokane, WA 99214 US * (1983).

This publication reports the available papers and formal discussions presented at the 51st Annual Meeting of the Western Snow Conference, as well as minutes of the Executive Committee and of the Business Meeting. Titles of papers presented are as follows: The isotope profiling snow gage: twenty years of experience; Snow temperature profiles in the central Sierra Nevada; Monitoring a rain-on-snow event; A comparison of U.S. and Canadian airborne gamma radiation snow water equivalent measurements; Snow accumulation and subsequent melt during rainfall in forested and clearcut plots in western Oregon; Analysis of three rain on snow floods in the Sierra Nevada, California; Snowmelt during rain-on-snow in coastal British Columbia; Rain on snow: shallow, transient snowpacks with frozen soils; A comparison of several snow accumulation and ablation algorithms used in watershed modeling; Application of a simple snowmelt-runoff model to large river basins; The influence of snowmelt in evaluating small hydropower generation potential; A continuous frozen ground index for flood forecasting; Structural snow loads; Rain-on-snow flood event in central Arizona; Local flood warning to support emergency maintenance of forest roads: a do it yourself method; Hydrologic response of central Sierra Nevada snowpacks to rainfall; Record rain-on-snow flooding in North Dakota; Snowfencing for mined-land rehabilitation; Snow and ice in Caribou-Poker Creeks research watershed, central Alaska; Reorganization of the USDA - soil conservation service - snow survey and water supply forecast activity; Application of a snow water-equivalent prediction model to rain-on-snow events in central Sierra Nevada; and Systems for evaluating snow accumulation on the high basins of Limay and Neuquen Rivers - Argentine Republic.

F10876
MING_KO WOO M * **Hydrologie nivale de l'Extreme Arctique du Canada** * Bull qual eaux * 8(1) 20-22,53-54 * Environ Can; Cent can eaux inter, Burlington, Ont * 1983-03.

Cet article passe en revue la documentation existante sur l'hydrologie nivale en milieu hyperboreen. Tous les ans, pendant neuf mois, les averses de neige constituent la principale forme de precipitation dans l'Extreme Arctique. Au printemps, la neige accumulee pendant des mois est liberee sur une periode relativement courte. Le moment et l'ampleur des crues sont fortement affectes par la quantite de neige tombee, par l'intensite de la fonte printaniere ainsi que la facon dont les eaux de fonte atteignent les cours d'eau. Le role dominant de la neige en hydrologie arctique indique que les recherches sur les processus physiques lies a la neige et a la glace devraient permettre d'ameliorer la qualite des previsions visant les phenomenes hydrologiques en milieu hyperboreen.

064174
MOFFATT D * **Snow in the biotic environment** . IN: Studies in snow and ice (a collection of student research papers and essays) * ROULET NT * Trent Stud Geogr, vol 8 * 163-168 * Trent Univ Geogr Soc, Trent Univ, Peterborough, Ont * 1980.

Snow is a broadly distributed environmental feature with considerable geographic variation in abundance, duration and character. In addition, it is an ephemeral, highly mutable feature of most temperate ecosystems, occurring in variable cycles. As a result, it plays a very significant role in the ecology and biogeography of snow regions. The author reviews literature on the effects that land-snowcover has on both plants and anima's and

suggests possible areas of research.

064165
OUTERBRIDGE K * **An analysis of the relationship of snow depth, water equivalent and density in the Elizabeth Lake basin, Labrador** . IN: Studies in snow and ice (a collection of student research papers and essays) * ROULET NT * Trent Stud Geogr, vol 8 * 51-61 * Trent Univ Geogr Soc, Trent Univ, Peterborough, Ont * 1980.

Results and methods of a detailed snow survey undertaken in central Labrador in mid-February, 1979 are given. Particular emphasis was placed on the relationship between snow depth and water equivalent in the four "landscape units" examined: Lake, Open Lichen Woodland, Close Lichen Woodland and Tundra. Various factors affecting these relationships are examined. An examination of the usefulness of the relationships for prediction of water equivalent is undertaken.

064163
PAUL P, O'NEIL L * **Snowcover variation with vegetation type in the Peterborough area** . IN: Studies in snow and ice (a collection of student research papers and essays) * ROULET NT * Trent Stud Geogr, vol 8 * 23-35 * Trent Univ Geogr Soc, Trent Univ, Peterborough, Ont * 1980.

Depth, water equivalent and snow density measurements were made for several different vegetation types in the vicinity of Peterborough, Ontario. Various statistical approaches were used to analyse relations between vegetation and snowcover. Results are discussed with reference to previous years' data. A note on the role of snowmobile trails in snowcover evolution is included.

061915
PERLA R, BECK TMH, CHENG TT * **The shear strength index of alpine snow** * Cold Reg Sci Technol * 6(1) 11-20 * Elsevier Sci Publ Co Inc, J Inf Cent, 52 Vanderbilt Ave, New York, NY 10017 US * 1982-08.

A shear frame (area 0.025 sq m) was used to measure an index of the shear strength of alpine snow. Shear indices were stratified according to snow crystal morphology, and then were correlated with measurements of snow density, temperature, and crystal size. The correlations of shear index with density were significant for all crystal morphologies except for the melt-refreeze morphology. Shear indices correlated erratically with snow temperatures and crystal size. Shear strength was also measured with a large rotary vane (0.5 m diameter). A comparison of rotary vane indices, shear frame indices, and slab avalanche measurements suggests that shear indices decrease with increasing sample size.

066162
PIERSON DC, TAYLOR CH * **The influence of snow on the input and movement of cations within a small watershed: methods and preliminary results** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

F12171
PLAMONDON AP, PREVOST M, NAUD RC * **Accumulation et fonte de la neige en milieux boise et deboise** * Geogr phys quaternaire * 38(1) 27-35 * Les Presses de l'Univ Montreal * 1984.

Les auteurs presentent une etude des caracteristiques physiques du couvert de neige en relation avec l'altitude, l'exposition et le couvert forestier. L'experience s'est deroulee a la foret Montmorency, sise a 80 km au nord de Quebec. Au cours des hivers 1981 et 1982, l'equivalent en eau maximal de la neige, pour l'ensemble du bassin du lac Laflamme, a ete de 28 et 29 cm, respectivement. Durant cette periode, les mesures effectuees n'ont pas permis de detecter l'effet des faibles differences d'altitude (50m) sur l'accumulation de la neige. L'equivalent en eau de la neige etait maximal dans les milieux decouverts et apparaissait plus important sous les jeunes peuplements que sous les vieux. Les jeunes sapinieres, entourees d'arbres plus hauts, agissent comme des pieges a neige. L'influence de l'exposition ne ressort que durant la periode de fonte, accelere d'une semaine sur les flancs sud. La fonte en sous-bois dure un mois et demi en moyenne et est ecourtee d'une a deux semaines dans les sites decouverts. Un modele de fonte, base sur les degres-jours, est finalement adapte Le coefficient de fonte est rajuste en fonction de deux periodes distinctes par la densite du manteau nival ou les degres-jours cumules.

062991
RACETTE DJ, GRIFFIN HD * **Snow sampling survey in the vicinity of Pluswood Manufacturing Limited, Atikokan** * 6p * Ont Minist Environ * 1981-11.

Since the summer of 1979, the Ministry of the Environment has received several complaints from residents living near a particle board plant located on the west side of the Town of Atikokan. These complaints alleged that Pluswood Manufacturing Limited was emitting excessive quantities of wood fines which were being deposited in the surrounding area. To determine the nature and extent of the fallout problem, the Ministry conducted a snow sampling survey near the Pluswood plant in February, 1981.

064176
ROULET NT (ED) * **Studies in snow and ice (a collection of student research papers and essays)** * Trent Stud Geogr, vol 8 * 19-p *

Trent Univ Geogr Soc, Trent Univ, Peterborough, Ont * 1980.

This report presents a collection of student research papers and essays on studies in snow and ice. The papers deal with snow studies, floating ice, both river and lake ice, and on the effects of these on their respective environments. A review of literature on the effects that land-snowcover has on both plants and animals is presented and particular attention to the mechanical processes of sea ice and influence on man is discussed. Various processes affecting the evolution of a lake cover are discussed, including deflation, redistribution, and constructive and destructive metamorphism. Reference is made to interrelationships between the snowcover and the development of white ice on a lake. At the end of the volume is a discussion of glaciological research at Trent University with a bibliography of publications of faculty and students.

064166
ROULET NT * **Snow depth distribution around spruce trees in the Chamonix Valley, France** . IN: Studies in snow and ice (a collection of student research papers and essays) * ROULET NT * Trent Stud Geogr, vol 8 * 62-67 * Trent Univ Geogr Soc, Trent Univ, Peterborough, Ont * 1980.

In mid-February, 1978, the distribution of snow around 10 spruce trees was sampled up to and beyond twice the radius of their crown perimeters. The range in snow depths was found to be far greater around individual trees than between trees. Areas of one standard deviation above the mean were located generally on the northern areas, while the areas of one standard deviation below the mean were found near the trunks of the trees. Regression analysis revealed strong correlations between distance from the center of the tree and snow depth of several areas. A possible method for using this information is suggested herein.

066163
ROULET NT * **Use of a computer mapping package in displaying areal representations of a snowcover** . IN: Proc Thirty-seventh Annual Eastern Snow Conf, June 5-6, 1980, Peterborough, Ont * GOODISON BE * 185-188 * (1980).

In February 1979, the snowcover distribution of the Elizabeth Lake basin was studied in relation to topography and vegetation. The sample density was calculated for the lake surface and a 631 random sample pattern was designed to obtain depth of snow, water equivalent, and snow density. The computer mapping package SYMAP was used to assist in reducing data. This paper discusses reasons why this package was chosen and how it operates. A description is also given of three types of maps found to be particularly useful: normal interpolation, third order trend surface, and first order residuals.

064172
ROULET NT, WOLFE BR * **The relationship between a lake ice and snowcover and zooplankton distribution** (see chapter 6.1 for complete reference - voir chapitre 6.1 pour la reference complete)

064168
SAGRIFF L * **Characteristics of snow distribution on Elizabeth Lake, Labrador** . IN: Studies in snow and ice (a collection of student research papers and essays) * ROULET NT * Trent Stud Geogr, vol 8 * 89-99 * Trent Univ Geogr Soc, Trent Univ, Peterborough, Ont * 1980.

The depth, density and water equivalent of the Elizabeth Lake snowcover are investigated. The influence of these components on the development of the lake cover is discussed. Both detailed stratigraphy and trend surface analysis are used to illustrate the spatial variability of the snowcover. Also possible parameters influencing the snowcover in light of the total cover and evolution are discussed, with particular reference to wind and topography.

065184
SHEWCHUK SR * **A snowpack chemistry study of small lakes in northern Saskatchewan** * SRC Tech Rep no 137 * 75p * Sask Res Counc, 30 Campus Drive, Saskatoon, Sask * 1982-08.

There exists a relationship between the chemical composition of precipitation in a region and the history of the air mass. The chemistry of snowpacks is a particularly good way to study regional pollution because a continuous record of materials accumulated from the atmosphere is maintained with time. The important sink mechanisms for air pollution are wet deposition (wash out and rain out processes), dry deposition and adsorption of gases. As part of Saskatchewan Environment's acid precipitation activities, two snow surveys were conducted under contract with the Air Pollution Control Branch on a number of small lakes in northern Saskatchewan during the winter of 1981-82. Twenty-six sites within the study area were used. The primary goals were to assess the chemical quality of the snowpack of northern Saskatchewan, study the deposition rates of various acidic substances and begin the assembly of a data base on snowpack chemistry. Results of these studies are given.

064162
STRICKLAND N * **Climate and snowcover in Schefferville, Quebec, winter 1978-1979** . IN: Studies in snow and ice (a collection of student research papers and essays) * ROULET

NT * Trent Stud Geogr, vol 8 * 17-22 * Trent Univ Geogr Soc, Trent Univ, Peterborough, Ont * 1980.

Snowcover development for the winter of 1978-1979 is traced for the Schefferville Region, Quebec. This winter is compared with existing climatic data with a view to assessing its "normality." The stage of the evolution of the snowcover is discussed for the study period of February 21-27, 1979.

062413
STRICKLAND N * **Factors affecting temporal variations in the albedo of snowcover** . IN: Proc of the Western Snow Conf, 50th Annual Meeting, Reno, NV, US, April 19-23, 1982 * 186-187 * (1982).

A study of relationships between snowcover albedo, snow characteristics, air temperature and precipitation in Southern Ontario. USACE equations were found to predict albedo relatively poorly in this warm, moist, snow environment.

047402
SURV BRANCH, ALTA RIVER FORECAST CENT * **Water supply outlook and snow survey bulletin, Alberta** (see chapter 4.11 for complete referece - voir chapitre 4.11 pour la reference complete)

062410
SWANSON RH, GOLDING DL * **Snowpack management on Marmot Watershed to increase late season streamflow** . IN: Proc of the Western Snow Conf, 50th Annual Meeting, Reno, NV, US, April 19-23, 1982 * 215-218 * (1982).

The forested portion of Twin subbasin of the Marmot Creek Experimental Watershed in Alberta, Canada, was harvested in a honeycomb pattern of 1-tree height diameter circular clearings during 1977-1979. Our goal for this treatment was to alter hydrograph shape in favour of least season streamflow. Our research on plot studies elsewhere indicated that at peak snowpack, this size clearing would contain 38 percent more snow than under uncut forest and that it would ablate 24 percent slower than either that under uncut forest or that accumulated in clearcuts larger than 3 to 5 tree heights across. These snow research findings suggested that the water yield from a catchment harvested in such tiny clearings might occur later in the water year -- a quite different time distribution than has been reported from harvests consisting of larger size clearcuts. For the first three years since treatment, 28 percent (50 mm) more snow water equivalent accumulated in the clearings than under adjacent treed patches. There has been no increase in total snowpack on the treated catchment. Annual water yield increased by 36 mm in 1980, 16 mm in 1981. There are insufficient data at this time to evaluate the effect on recession flow. Northern Forest Research Centre, Edmonton, Alberta University of British Columbia, Vancouver, British Columbia

F11392
TOUPIN J * **La dynamique de l'enneigement en milieu peri-urbain: le cas de Trois-Rivieres-Ouest** * Geoscope * 13(2) 77-94 * Dep geogr, Univ Ottawa * 1983-03.

Pendant l'hiver 1978-1979, des donnees sur l'epaisseur de la neige, la vitesse et la direction du vent furent relevees a partir de 30 stations nivales prealablement etablies sur la municipalite de Trois-Rivieres-Ouest. Grace a ces chiffres, cinq secteurs d'enneigement ont ete classifies selon l'importance de leur epaisseur en neige pour une periode de trois mois soit: l'espace occupe par le feuillu, l'espace occupe par le conifere, les terres en friche, le milieu urbanise et le milieu ouvert. Ce travail montre que l'epaisseur de la neige au sol est etroitement liee a l'utilisation du sol et a la vitesse locale du vent.

066156
TRIVETT NBA, WATERMAN SE * **Evaluation of the spatial and temporal distributions of snowpack parameters in the Saint John River basin** . IN: Proc Thirty-seventh Annual Eastern Snow Conf, June 5-6, 1980, Peterborough, Ont * GOODISON BE * 19-35 * (1980).

The spatial distributions of snow depth and snow water equivalent are known to be related to vegetative cover type and physiographic parameters such as elevation, slope and aspect. This paper examines some of these relationships for the Saint John River Basin. A number of objective techniques including multiple curvilinear regression and trend surface analysis are used to estimate snow water equivalent values for 100 sq km grid elements within the basin. The snow courses were divided into forested and non-forested data sets and the models applied separately to each data set. The grid values, derived from each model, were used to calculate areally weighted snow water equivalent values for each of 56 sub-basins. This approach is being further extended by the inclusion of more accurate forest cover information derived from the analysis of satellite data. Through this study it is hoped to evaluate the suitability of the current snow course network for flood forecasting in the Saint John River Basin.

067128
VAN WACHEM R, JONES KH, HOPKINSON RF * **A comparison of snow survey water equivalent to accumulated winter precipitation measured by the standard A.E.S. Nipher-shielded snow gauge** * CSS-R83-04 * vp * Environ Can, Atmos Environ Serv * 1983-12.

Snow survey water equivalent was compared to accumulated precipitation of the standard

A.E.S. Nipher-shielded snow gauge at selected stations in Saskatchewan and Manitoba using regression analysis. A t-test was conducted on the slope of each relation to see if it differed significantly from unity. There was a large variation in the relationship between the two measurements from station to station and this was mainly attributable to relative differences in siting of the respective snow courses.

066160
WATERMAN SE * **Modelling of shortwave radiation for snow covered terrain** . IN: Proc Thirty-seventh Annual Eastern Snow Conf, June 5-6, 1980, Peterborough, Ont * GOODISON BE * 144-158 * (1980).

A solar radiation model is described which is capable of calculating the spectral distribution of the direct and diffuse components of the solar radiation incident upon a snow covered surface in clear-sky conditions. The model accounts for upwelling radiation backscattered toward the earth's surface, radiation reflected to a point from the surrounding terrain, and the anisotropy of the diffuse flux. Input of the spectral reflectance characteristics of the terrain allows calculation of the shortwave radiation absorbed by the snow surface. The accuracy of the model is assessed by comparison with available data. Calculation of the net shortwave radiation received by inclined snow surfaces demonstrates the importance of terrain reflection and atmospheric backscattering in the shortwave radiation balance of snow covered terrain. These calculations further demonstrate that the majority of the solar radiation absorbed by snow surfaces is in the near infrared region of the spectrum. The results of the investigation suggest that it may be possible to omit the diffuse flux in calculations of net solar radiation over large areas of extensive snow cover.

065759
WIGHAM JM, LAING B * **A physical model of small-depth flows in porous media** , IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * v1 287-299 * Can Soc Civ Eng * (1983).

The overland flow that occurs during snowmelt results from water movement through a saturated layer of snow particles at the base of the pack. The flow process is similar to that of interflow in soils in that the flow depths are small and flows occur through a porous media on a sloping surface. A physical model of the flow system was constructed. A series of tests were run to evaluate the model system and to determine the applicability of a kinematic wave approach to calculating flows. The results of the evaluation tests indicated satisfactory accuracy was achieved in modelling the system. The preliminary test results on the model showed agreement with the form of the hydrograph calculated from kinematic wave equations though there were some differences between observed and calculated times of concentration.

062409
WILSON J (CHAIRMAN) * **Proceedings of the Western Snow Conference, 50th Annual Meeting, Reno, NV, US, April 19-23, 1982** * 225p * (1982).

The Western Snow Conference is celebrating its 50th anniversary this year in Reno, Nevada. The WSC finds its origin here in 1933, under the initial guidance of Dr. James E. Church, at that time a Professor of Classics at the University of Nevada. Following those early formative years, many individuals have been important to the growth of the Conference. The scientific and technological papers presented at the annual meetings have influenced the investigations of snow hydrology throughout the world. The WSC bibliography indicates the total number of papers which have been published in the Proceedings now exceeds 700. This historic organization continues to serve many important functions at the national and international levels within the fields of snow hydrology and meteorology.

066161
WOLFE BR * **The role of the lake winter cover in the phosphorus budget of a southern Ontario lake** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

062416
WOO M * **Snow hydrology of the High Arctic** , IN: Proc of the Western Snow Conf, 50th Annual Meeting, Reno, NV, US, April 19-23, 1982 * 63-74 * (1982).

In the Canadian Arctic Islands, snowfall is the major form of precipitation. At the end of winter, snow distribution is highly uneven, reflecting the strong influence of local terrain upon snow drift. The snowpack is denser and harder than that of the subarctic and stratigraphically, it comprises a number of windslabs and hoar layers. During spring, snow accumulated over many months are released within a short spell. The magnitude and timing of floods are controlled by the amount of winter snowfall, the intensity of spring melt and the variable source of meltwater due to fragmentation of the basin snow cover. When meltwater reaches the snow-choked valleys, numerous snow jams further modify the flow. In view of the preponderant influence of snow on arctic hydrology, advancement in snow research will have significant applications to northern development.

063048
WOO MK * **Snow hydrology of the Canadian high arctic** * Water Qual Bull * 8(1) 19-21,52 * Can Cent Inland Waters, WHO Collaborating Cent Surf Ground Water Qual, Burlington, Ont * 1983-01.

The Canadian High Arctic is a barren polar region where tundra vegetation occurs only in more favoured localities, and where snow forms an integral part of the landscape for over 9 months each year. Most rivers are short and their drainage basin area seldom exceeds 2000 sq km. All basins are underlain by permafrost. A large proportion of solar radiation is reflected because of the high reflectivity of snow. This paper provides a review of available literature on snow hydrology in a high arctic environment. Over 60% of precipitation is snowfall, mostly between September and May. The snow is redistributed by the wind, and as vegetation is sparse, topography and wind direction control the pattern of drifting and the resultant snow distribution. Snowmelt is delayed in the spring, since solar radiation energy is reflected by the snow, and some is used in heating the air. When the entire snowpack reaches 0 C, snow ablation accelerates, enhanced by 24 hours of daylight. The timing and magnitude of floods are strongly affected by the amount of snowfall, the intensity of spring melting and the manner in which meltwater reaches the streams. Our understanding of hydrologic processes operating in the polar region is sadly inadequate. We should not apply indiscriminantly knowledge gained in temperate latitudes.

6.3 Glaciers - Glaciers

054321
CAMPBELL RB, RAMPTON VN * **The story of the rocks and glaciers, Chapter 1** , IN: Kluane, Pinnacle of the Yukon * THEBERGE JB * 3-17 * Doubleday Can Ltd, Toronto, Ont * 1980.

This chapter describes the geological history of the rocks, mountains, and glaciers in St. Elias Mountains in Kluane National Park, Yukon. Mt. Logan (19,525 feet), Canada's highest mountain, is found here as well as more than 2,050 glaciers. Many of the world's largest and longest valley glaciers outside the polar regions flow from the icefield that straddles the divide between the Pacific Ocean and the Yukon River. The geological timetable extends from the Cambrian to the quaternary and events in the geological history of the St. Elias Mountains for the last 60 million years are charted. Also, glacial chronology and related events during the last 100,000 years in and near the mountains are described.

066114
DAVIDSON-ARNOTT R, NICKLING W, FAHEY BD (ED) * **Research in glacial, glacio-fluvial, and glacio-lacustrine systems, Proceedings of the 6th Guelph Symposium on Geomorphology, 1980** * Dep Geogr, Univ Guelph Geogr Publ No 6 * 318p * Geo Books, Regency House, 34 Duke St, Norwich NR3 3AP, GB * 1982.

The basic theme for the 6th symposium was that of research in glacial, glacio-fluvial, and glacio-lacustrine/marine systems. It was kept broad, for earth scientists from backgrounds incorporating both geography and geology to discuss their common research goals. Fourteen of the 16 papers presented appear in the proceedings; abstracts of the remaining 2 are provided in the appendix. The first session dealt with glacial erosion and deposition; the second, with glacio-fluvial sedimentation and processes; and the third with glacio-lacustrine and marine sedimentation.

066686
ENVIRON CAN, WATER SURV CAN, CALGARY DISTRICT OFF * **Survey of the Athabasca and Saskatchewan Glaciers, 1978 - 1980** * 36p * Water Surv Can, Calgary Dist Off, Inland Waters Dir, West North Reg, Environ Conserv Serv, Environ Can, Calgary, Alta * 1982-12.

Glacier surveys are carried out in order to establish a chronological record of changes in glacier size, shape and movement rates. Field data provide information from which the glaciologist can determine the relationship between long-term climatological changes, rates of advance or recession, and ablation. Data on glacier melt contribution to streamflow is also obtained. On the eastern slopes of the Rocky Mountains, glacier inventory data are being obtained by Water Survey of Canada, Calgary and Special Services and Surveys Section, Applied Hydrology Division, Ottawa. The Calgary District of Water Survey of Canada has collected data on toe location and plaque line movement on a number of glaciers since 1945. The Special Services and Surveys Section has recorded volumetric changes of the Athabasca and Saskatchewan Glaciers by use of both aerial and terrestrial photogrammetry since 1959. This report covers in detail the field data collected by Water Survey of Canada, Calgary, on a biennial basis. The surveys are presently restricted to the Athabasca and Saskatchewan Glaciers, on which the following data is collected; (a) position of the toe (relative to fixed survey points), (b) plaque line movement, and (c) the ablation of the glacier at the plaque line location. A brief outline is also given in this report of some previous historical studies and scientific investigations which have been carried out on the Athabasca and Saskatchewan Glaciers by other agencies and individuals. The present report has been updated to include results of the 1978 and 1980 surveys.

054318
GEIST V * **Ice-age mammals, glaciers, and man, Chapter 4** , IN: Kluane, Pinnacle of Yukon * THEBERGE JB * 44-51 * Doubleday Can Ltd, Toronto, Ont * 1980.

This chapter describes the types of mammals that were and are present in the glaciers of the St. Elias Mountains in Kluane National Park, Yukon. Also described are the successive advances of continental glaciers which coincided with the appearance of some of the largest mammals ever to arise in the last 10 million years from the little ice ages of the Villafranchian to the major ice ages that began some 1.8 million years ago. Today 14 species of large mammals live in the St. Elias Mountains. It describes the highly productive ecosystems, especially loess steppe and sedge meadows that exist in the periglacial environments in low latitudes. The diverse assemblage of discrete plant communities is also discussed.

062397
LUM-SHUE-CHAN KR * **Dissolved and particulate trace metals in meltwater from the Rhone glacier** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

064071
NAROD BB, CLARKE GKC * **UHF radar system for airborne surveys of ice thickness** * Can J Earth Sci * 20(7) 1073-1086 * 1983-07.

We describe an 840 MHz pulsed radar system developed for airborne sounding of polar glaciers and ice caps. The system performance (ratio of transmitter power to minimum detectable signal) is 126 dB. A sampling time base converts the received signal to audio frequencies, and data are recorded in analogue form on magnetic tape. Computer-enhanced time sections for a glacier and an ice shelf are presented as examples.

F10238
OMMANNEY CSL * **Bibliographie de la glaciologie canadienne, 1982 - Bibliographie No 3/Iles de glace de l'ocean Arctique** * Rapp no 21 IHRH; Etude no 73, Ser rapp gen DGEI; Note no 11 Inv glaciers * 40p * Environ Can, Inst natl rech hydrol, Dir gen eaux inter, Ottawa, Ont * 1982.

Les references aux rapports sur les iles de glace de l'ocean Arctique font depuis longtemps partie des dossiers d'information du Projet canadien d'inventaire des glaciers, en raison de leur pertinence pour la glaciologie du nord de l'ile Ellesmere, ou des plates-formes de glace donnent naissance a la plupart des iles de glace. Au cours de l'occupation de ces iles, stations scientifiques flottantes, on a effectue beaucoup d'etudes sur leur composition et leur comportement. Cette documentation revele egalement bien des choses au sujet des regions d'origine. Ces dernieres annees, l'activite industrielle croissante dans l'ocean Arctique a encore une fois attire l'attention sur les iles de glace en tant que menaces eventuelles aux ouvrages eriges en mer. Pour repondre aux demandes du secteur industriel et avec l'encouragement du Groupe de travail sur la glace du Comite consultatif canadien de la teledetection, il a ete decide d'accroitre la diffusion de ces renseignements. La presente bibliographie doit etre consideree comme completement a celle qui traite des "Glaciers et plates-formes de glace de l'ile Ellesmere".

065732
OSBORN G * **Characteristics of the bergschrund of an avalanche-cone glacier in the Canadian Rocky Mountains** * J Glaciol * 29(101) 55-69 * 1983.

Field study of the bergschrund of a small avalanche-cone glacier at the base of Mt Chepren, in Banff National Park, has been carried out as part of a general exploratory study of glacier-head crevasses in the Canadian Rockies. The bergschrund consists of a wide, shallow, partly bedrock-floored gap, underneath which extends a nearly vertical Randkluft, and a small, offset, sudsidiary crevasse (or crevasses). The following observations regarding the behavior of the bergschrund and ice adjacent to it are of particular interest: (1) topography of the subglacial bedrock is a control on the location of the main bergschrund and subsidiary crevasses, (2) the main bergschrund and subsidiary crevasse(s) are connected by subglacial gaps between bedrock and ice; the gaps are part of the "bergschrund system", (3) snow/ice immediately down-glacier of the bergschrund system moves nearly vertically downward in response to rotational flow of the glacier, allowing the bergschrund components to keep the same location and size from year to year, (4) an independent accumulation, flow, and ablation system exists in the snow/ice up-glacier of the bergschrund system, (5) most of the void space in the bergschrund system is maintained through the winter, although the wide, shallow part of the main bergschrund fills up with snow, (6) some mass transfer of snow/ice occurs across the bergschrund system, (7) displacement across the bergschrund due to flow of the main glacier body results in significantly more snow being deposited each winter down-glacier of the bergschrund than up-glacier of it.

062491
PATERSON WSB * **The physics of glaciers, second edition** * 372p * Pergamon Press Can Ltd, Suite 104, 150 Consumers Rd, Willowdale, Ont M2J 1P9 * 1981.

The aim of this book is to explain the physical principles underlying the behavior of glaciers and ice sheets. It is intended

primarily for those starting research in the subject, but established workers in glacier studies and related fields will find it useful. The treatment is at about the graduate student level. Subjects covered are: the transformation of snow to ice; structure and deformation of ice; the mass balance of a glacier; glacier measurement techniques; ice deformation; basal sliding; hydrology of glaciers; flow of ice sheets and ice shelves; distribution of temperature in glaciers and ice sheets; structures and fabrics in glaciers and ice sheets; the response of a glacier to changes in mass balance; glacier surges; heat budget and climatology of glaciers; and ice core studies.

054320
RAGLE RH * **The glaciers: nature's sculptors, Chapter 2** , IN: Kluane, Pinnacle of Yukon * THEBERGE JB * 18-30 * Doubleday Can Ltd, Toronto, Ont * 1980.

This chapter describes various aspects of glaciers in the Kluane National Park, Yukon. The term "glacier" is defined and areas covered include anatomy of a glacier, active ice, surging glaciers, glaciers and climate, and glacier sculpture. A glossary of terms is provided at the end of the chapter.

062468
SHILTS WW * **Glacial dispersal - principles and practical applications** * Geosci Can * 9(1) 42-47 * 1982-03.

Glacial dispersal, the process of glacial erosion, transporation and deposition, has distorted the bedrock signatures on overlying surficial sediments and soils in most of Canada. Buffering components, such as carbonate minerals, which mitigate the effects of acid rain have been dispersed across Precambrian terrane in eastern Ontario in patterns that reflect several principles of glacial dispersal. Dispersal trains of boulders, minerals, and trace elements may enhance the size of mineral exploration targets by several times. By using appropriate analytical strategies and knowledge of dispersal, the source mineralizations can be found, as illustrated by an example of dispersal of nickel from the District of Keewatin. One other way dispersal principles have been applied has been to calculate the volume of material dispersed from a particular source outcrop. Dividing that volume by outcrop area yields average depth of glacial erosion, an important parameter to consider in selecting minimum depths for burial of long-lived radio-active waste.

F10642
SIMON C, OMMANNEY L * **Bibliographie de la glaciologie canadienne, 1982 - bibliographie no 2/glaciers et plates-formes de glace de l'ile Ellesmere** * Rapp no 20 de l'INRH; Etude no 58, Ser rapp gen DGEI; Note no 9 de l'inventaire des glaciers * 53p * Environ Can, Inst natl rech hydrol, Dir gen eaux inter, Ottawa, Ont * 1982.

Au cours des annees, des renseignements sur les glaciers se trouvant au Canada ont ete recueillis dans le cadre du Projet canadien d'inventaire des glaciers. Vu la croissance de l'activite industrielle dans le haut Arctique, et notamment du forage sous-marin et de la navigation, il existe un besoin renouvele de renseignements sur les glaciers et platesformes de glace qui pourraient causer des difficultes au large ainsi que sur les conditions glaciologiques qui les entretiennent. Pour repondre aux demandes du secteur prive et avec l'encouragement du Groupe de travail sur la glace du Comite consultatif canadien de la teledetection, il a ete decide d'accroitre la diffusion des renseignements sur les glaciers et les platesformes de glace de l'ile Ellesmere. Il est a noter qu'il existe une bibliographie connexe dans la presente collection, intitulee "Iles de glace de l'ocean Arctique".

054312
THEBERGE JB (ED) * **Kluane, Pinnacle of the Yukon** * 175p * Doubleday Can Ltd, Toronto, Ont * 1980.

This volume contains 15 chapters written by scientists on various aspects of the Kluane region and the St. Elias Mountains in the Yukon. It is organized into three parts: "The Elements" dealing with the mountains, glaciers and the climate; "Living Things" about the flora, birds, mammals, and fish; and "Man", including accounts of prehistoric man and modern man, the history of mountaineering and flying, and a description of some easy climbing routes in the Kluane Ranges. An appendix of common and scientific names of flora, birds, mammals, fish and invertebrates mentioned in the text is included as well as an appendix with suggestions for visitors to the St. Elias Mountains and Kluane National Park.

7. SEDIMENTATION AND EROSION - SEDIMENTATION ET EROSION

7.1 Fluvial Processes - Processus fluviaux

064631
Lesser Slave Lake Regulation, Environmental Impact Assessment, Volume III, Land use impact studies (see chapter 4.5 for complete reference - voir chapitre 4.5 pour la reference complete)

066012
Atlantic coastal erosion and sedimentation workshop; papers presented at the Atlantic coastal erosion and sedimentation workshop, held November 25, 1982 in Halifax, N.S. * 113p * 1982-11-25.

Presentations made at the Atlantic Coastal Erosion and Sedimentation Workshop discussed typical coastal erosion problems, transgressive coastal sedimentation along the eastern shore of Nova Scotia, and seismic signal processing for geotechnical properties applied to marine sediments. Some legal considerations with respect to erosion and sedimentation were also presented at the Workshop. Practical discussions included a presentation on the use of concrete and soil cement for shore protection.

066129
Sediment/freshwater interaction, Proceedings of the Second International Symposium held in Kingston, Ontario, 15-18 June 1981 * Hydrobiologia * v91/92 700p * 1982-07-16.

The Second Symposium focussed upon research into the source, transfer and fate of mineral and organic sediments, including colloidal materials, in both fluvial and lacustrine systems. The roles of biochemical and geochemical cycling of sediment related nutrients and contaminants, in transportive and depositional environments, were central to this approach. Six major themes provided the framework of the symposium: summary of sediment dynamics and distribution in fluvial and lacustrine environments; Land use effects on sediment yields and quality; Sediments in mass balance models, including total loadings; Sediments as concentrating mechanisms of natural and anthropogenic, organic and inorganic materials; Release mechanisms, and transfer to biosystem, from bed and suspended solids; and Short- and long-term dating methods, spatial and temporal consistency, bioturbation and diffusion. More than 80 presentations were made, of which 68 appear in the publication.

066140
ADAMS DD, MATISOFF G, SNODGRASS WJ * **Flux of reduced chemical constituents (Fe sup 2+, Mn sup 2+, NH4 sup + and CH4) and sediment oxygen demand in Lake Erie** , IN: Sediment/Freshwater Interaction, Proc 2nd Int Symp, Kingston, Ont, 15-18 June 1981 * Hydrobiologia * v91/92 405-414 * 1982-07-16.

Sediment pore water concentrations of Fe sup 2+, Mn sup 2+, NH4 sup+ and CH4 were analyzed from both diver-collect-cores and an in situ equilibration device (peeper) in Lake Erie's central basin. Sediment oxygen demand (SOD) was measured at the same station with a hemispheric chamber (including DO probe and recorder) subtending a known area of sediments. The average SOD was 9.4 mM per sq m per day (0.3 g per sq m per day). From pore water gradients within the near-surface zone, the chemical flux across the interface was calculated indirectly using Fick's first law modified for sediments. These calculations, using core and peeper gradients, always showed sediment loss to overlying waters, and variations between the two techniques differed by less than an order of magnitude for Fe sup 2+ and CH4. The transport of these reduced constituents can represent a sizeable oxygen demand, ranging from less than 1% for Fe sup 2+ and Mn sup 2+ to as high as 26% for NH4 sub+, and 30% for CH4. The average flux of these constituents could account for about a third of the SOD at the sediment-water interface of this station.

F10475
ANGLEJAN B * **Etudes sedimentologiques dans l'estuaire de la riviere Eastmain en 1980 et 1981** * 76p * Groupe interuniversitaire de recherches oceanogr du Que * 1981-12.

Ce rapport presente des etudes sur les depots recents de l'estuaire de la riviere Eastmain effectuees en 1980 et 1981 dans le but de determiner les effets du detournement de l'Opinaca et de l'Eastmain sur la repartition et le transport des sediments a l'interieur de l'estuaire et dans la partie limitrophe de la baie James affectee par le panache de la riviere. Le rapport est divise en cinq parties: 1) les aspects physiques et hydrologiques du bassin de la riviere Eastmain 2) la sedimentologie des depots recents de l'estuaire de la riviere Eastmain 3) les etudes de la matiere en suspension 4) les effets de la coupure sur la sedimentation et les previsions sur l'evolution future de l'estuaire.

062520
ASHMORE P, PARKER G * **Confluence scour in coarse braided streams** * Water Resour Res * 19(2) 392-402 * 1983-04.

Laboratory models of a braided valley flat in coarse material were used in conjunction with field data to study confluence scour at braid anabranches. Correct prediction of the depth of scour is required for the design of buried pipeline crossings. Braid pattern and anabranches constantly shift and avulse so that scour holes have definable lifetimes. Although the scatter is large, the depth of water in the scour hole depends on confluence and relative anabranch discharge; this depth can be as high as six times the ambient depths in the anabranches.

062918
BAARSCHERS WH, ELVISH J, RYAN SP * **Adsorption of fenitrothion and 3-methyl-4-nitrophenol on soils and sediment** * Bull Environ Contam Toxic * 30(5) 621-627 * 1983-05.

Absorption of pesticides and their degradation products on soils and sediments

plays a major role in the environmental fate of such chemicals. Fenitrothion is an insecticide of economic significance in Canada. Its major degradation product, 3-methyl-4-nitrophenol, was shown to be more toxic to microorganisms than the parent compound. Of the extensive literature on pesticide adsorption, few reports on fenitrothion adsorption are available. Therefore the adsorption characteristics of fenitrothion and 3-methyl-4-nitrophenol on several soils were studied, and the results of this study are reported here.

065816
BELL GL, EADIE BJ * **Variations in the distribution of suspended particles during an upwelling event in Lake Michigan in 1980** * J Great Lakes Res * 9(4) 559-567 * 1983

To test the hypothesis that suspended fine-grained particles moving downslope within the nepheloid layer in Lake Michigan are periodically reintroduced into the nearshore and euphotic zones during upwelling events, temperature and transparency profiles were recorded and water samples analyzed for total suspended materials (TSM) during a strong upwelling event. The resultant data confirmed that there is periodic reintroduction of suspended materials into the nearshore and epilimnion during such events, and provided insight into the importance of the general resuspension process, especially in regard to differences between known sedimendation rates and the rate indicated by trap collections. Both upwelling and downwelling currents are disruptive processes that tend to keep the suspended particulates in motion and prevent them from rapidly becoming a permanent part of the bottom sediment. These currents redistribute suspended particulates and the associated chemical load, and may resuspend surficial sediments, especially from the slope and shelf regions. The reintroduction of fine-grained materials into the euphotic zone through upwelling events can play a large role in the long-term behavior and fate of persistent contaminants.

062757
BOCZAR-KARAKIEWICZ B, LONG BF, DRAPEAU G * **Formation and modification of a system of sand bars by progressive gravity waves in the presence of tides (on an example from the north coast of the St. Lawrence Gulf)** , IN: Proc Canadian Coastal Conf 1983, Vancouver, 11-14 May 1983 * HOLDEN BJ * 37-51 * Natl Res Counc, Assoc Comm Res Shoreline Erosion Sediment, Ottawa, Ont K1A 0R6 * 1983.

The formation of sand bars on a gently sloping beach by wind generated surface gravity waves, and various aspects of the modification of a bar system due to tides, changing sediment supply and intensity, are considered with regard to a site on the north coast of the St. Lawrence Gulf. A model (based on the Boussinesq equations), explaining the mechanism of bar formation has predictive power as regards the collected field measurements. The results indicate that a number of factors control the main properties of a multiple, shore-parallel bar system: the number, location and distances between successive crests in a system of bars depend on the mean slope gradients and the incident wave parameters.

065751
BRAY DI * **Study of channel changes in a reach of the North Nashwaakis Stream, N.B.** , IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * 107-127 * Can Soc Civ Eng * (1983).

Repeated surveys of a short channelized reach of the North Nashwaaksis Stream near Fredericton, N.B. over a 10 year period provides the basis for evaluating the type and magnitude of some physical and biological changes in the study reach. The length of the study reach is about 100 m and the drainage area above the site is about 25 sq km. The processes of channel widening and the subsequent colonization of a mid-channel bar are documented. Estimates are presented of the relative contribution of bank material to the suspended sediment load during the most significant flood of record. This case study provides useful information for those planning channelization projects on small to intermediate size streams in similar areas.

065906
BUCKLEY DE, WINTERS GV * **Geochemical transport through the Miramichi Estuary** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

F12063
CATALIOTTI-VALDINA D, LONG BF * **Evolution estuarienne d'une riviere regularisee en climat sub-boreal: la riviere aux Outardes (cote nord du golfe du St-Laurent, Quebec)** * J can sci terre * 21(1) 25-34 * 1984-01

L'evolution sedimentologique de l'estuaire de la riviere aux Outardes a ete fortement modifiee durant et apres la phase de construction des barrages hydroelectriques sur la riviere. Avant 1965, le debit fluvial dominant etait de 1350 m cubique/s et le debit maximum de crue de 2700 m cubique/s. Entre 1965 et 1975, durant la periode des travaux, il chuta a 430 m cubique/s et il est maintenant regularise a 555 m cubique/s depuis 1975. Les fluctuations actuelles varient de 1300 m cubique/s lors des deversements a 0 m cubique/s durant certaines periodes de remplissage. Les variations importantes du debit fluvial, dues a la creation des reservoirs, ont change les equilibres sedimentaires et le principal but de cette

recherche est d'approfondir la connaissance du mouvement des materiaux non-cohesifs dans l'estuaire. Avant la regularisation, les processus sedimentaires etaient domines par les variations saisonnieres du regime de la riviere: les pics de crues permettaient de laver tout l'estuaire de son materiel fin. Entre 1965 et 1975, le debit fluvial decroit et le prisme de maree migre vers l'amont. Le taux d'erosion des falaises de bordure a diminue au cours de la phase des travaux de regularisation et l'entree de materiel d'origine marine s'est accentuee principalement a l'embouchure ou l'influence de la houle et de la maree est plus importante que l'effet du debit fluvial. Dans le systeme estuarien actuel, le budget sedimentaire est positif et la source des materiaux non-cohesifs a change depuis la regularisation de la riviere. Il s'etablit a l'heure actuelle un nouvel equilibre entre les processus fluviaux et marins. Une comparaison est etablie entre les processus hydrodynamiques regnant dans le milieu estuarien de la riviere aux Outardes et ceux de rivieres non regularisees de climat sub-boreal comme la riviere St-Jean et la riviere La Grande.

061847
CBCL LTD & ASSOC * **Environment Canada, Mercury reduction in sediments** * vp * 1981-11.

This report summarizes all relevant data resulting from research done by CBCL Limited into the relationship between mercury and various types of sediments, methods of material handling, chemical and organic treatment options, operational criteria and conceptual process plant design. The object of the program was to evaluate the viability of removing mercury from contaminated sediments. A laboratory analysis was undertaken on samples of contaminated material collected from affected areas in Dryden, Ontario, Noranda, Quebec, and Pinchi Lake, British Columbia. This examination indicated that the type of contaminated sediments varied. It was concluded that dewatering would be an appropriate primary process returning the bulk of the water to its source before any form of sediment cleaning. Various dewatering methods were investigated, but no method was found to accomodate the multivarious fractions of material. It was noted that mercury could be easily vaporized off the sediments into a gas flow at a low temperature and then collected by amalgamation using a variety of noble and common metals. The mercury vapour could be economically collected from a hot gas stream by using activated carbon as a substrate. A complex mechanical dewatering system designed to deal with the wide spectrum of mercury laden sediment types is described. The complete processing plant is proposed as a mobile facility. A unique sediment collecting dredge has been designed to recover the sediments with a low water content. With the system described, contaminated areas can be restored to within acceptable levels of toxicity, with minimum disruption or environmental damage to the ecosystem. The recommended action resulting from this study is that a prototype system and processing plant be designed, constructed and positioned for trials and operational refinement at the upstream end of the contaminated area in the Wabigoon River at Dryden, Ontario. A literature review was undertaken as part of this study and is presented in a separate volume.

063667
CHAPMAN PM * **Measurement of the short-term stability of interstitial salinities in subtidal estuarine sediments** * Estuarine Coastal Mar Sci * 12(1) 67-81 * 1981-01.

Diurnal comparisons of sediment interstitial salinities with those of the immediately overlying water were conducted subtidally at five stations in the Fraser River estuary, B.C. These in situ studies indicated that the interstitial salinities of sediments containing a high proportion of silt were relatively constant despite large fluctuations in water column salinities; however, in sands, interstitial salinities closely followed diurnal salinity variations in the water column. Laboratory penetration studies were conducted using relatively undisturbed natural sediments. The results of the in situ and laboratory studies indicated that exchange between the interstitial and overlying water was influenced by three major factors: the rate of water flow above the sediment, the relative salinities of the interstitial and overlying water and the sediment composition.

063635
CHARLTON MN * **Downflux of sediment, organic matter, and phosphorus in the Niagara River area of Lake Ontario** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

065774
CHEE SP, KUNG T * **Theoretical configurations of scour basins** , IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * v2 569-579 * Can Soc Civ Eng * (1983).

Self-formed scour holes produced by diving water jets in granular beds were analysed theoretically and investigated with the aid of laboratory observations. From these stream geometry relations, plunge basins used for the energy dissipation of water jets could be proportioned for design.

062246
CHEN RL, KEENEY DR, MCINTOSH TH * **The role of sediments in the nitrogen budget of lower Green Bay, Lake Michigan** * J Great Lakes Res * 9(1) 23-31 * 1983.

The extreme southern portion of Green Bay is a shallow (1 to 5 m depth), eutrophic water body which receives considerable nutrients from the Fox River and metropolitan Green Bay, Wisconsin. Research to evaluate the effect of sediments on nitrogen (N) in the bay entailed periodic sampling of waters and sediments at six sites over 20 months and laboratory investigations of the rates of nitrification, denitrification, mineralization, immobilization, and N2 fixation. The monitoring data indicated that the N concentrations, approximately 0.6 and 0.8 mg/L of inorganic and organic N, respectively, in the bay waters are considerably higher than the threshold limits that may cause algal bloom and aquatic weed problems. Consideration of the available sediment N pool with respect to recognizable N inputs indicated that only 1.2 percent of the yearly N loading from the Fox River is present in the active sediment layer. Nitrification and subsequent denitrification at the sediment-water interface as a result of intermittent wind stirring could be a major sink for N, but presently it has a minor impact due to the high loading rate of N in this ecosystem. The study indicates that even if approximately 50 percent of the present point source loading of N were eliminated by pollution abatement, the N input from nonpoint sources (combined with existing concentrations of phosphorus in the bay waters) would be sufficient to maintain eutrophic conditions.

061826
CLAIR T, NORTON G * **Regeneration of lake sediment aluminum and phosphorus at varying pH's, Appendix 1** * vp * 1980-08.

This study examines increases in acidity in water overlying Kejimkujik sediment cores to determine if they would change aluminum and dissolved orthophosphate concentrations in water. Twelve sediment cores collected from Kejimkujik Lake, Nova Scotia, were incubated with overlying water of various pH's. This water was then analyzed for extractable aluminum, dissolved orthophosphate and hydrogen ion concentration. Results indicated that: 1) sediments in cores varied in composition but were generally composed of 3-4 mm of organic material overlying 5-10 cm of sand on top of clay; 2) analysis of sediment extractable aluminum and total phosphorus showed no wide variations in concentrations; 3) no relationship is shown between orthophosphate and pH but some shown between aluminum and pH; 4) linear regression results of sediment - water exchange experiment suggest that 46% of the variability around regression line could be caused by pH, leaving 54% due to other reasons, most likely, variability in the sediment composition.

064689
CROSS PM, RIGLER FH * **Phosphorus and iron retention in sediments measured by mass budget calculations and directly** * Can J Fish Aquat Sci * 40(10) 1589-1597 * 1983-10.

Retention of phosphorus (P) and iron (Fe) was estimated from mass budget calculations of Bob Lake, Ontario. Ratios of Fe to P in sediment cores were used to test the reliability of the concurrent retention estimated. However, a 300% range in Fe to P ratios measured in vertical profiles in sediments was many times larger than the uncertainty associated with mass budget measurements. Sediment cores showed a near-surface maximum of iron but not phosphorus. There was reasonably good agreement between P retention as computed by mass budget and by sediment accumulation methods, though the latter were slightly higher.

062755
CUYPERS L, LUTERNAUER JL * **Sedimentation on the Stikine River delta, southeastern Alaska - an introduction** . IN: Proc Canadian Coastal Conf 1983, Vancouver, 11-14 May 1983 * HOLDEN BJ * 89-103 * Natl Res Counc, Assoc Comm Res Shoreline Erosion Sediment, Ottawa, Ont K1A OR6 * 1983.

Sand flats crossed by shallow braided channels constitute most of the intertidal surface (approximately 200 sq km) of the Stikine River Delta. A major marsh formed on the upper intertidal surface of the southern part of the delta as prograded at an average 20 m/a. Wide fluctuations in grain size distributions in a 2 km wide zone between the marsh and the outer, sand flats probably are linked to seasonal variations in fluvial and eolian sediment transport. The delta slope is prograding mainly off the principal distributaries of the southern tidal flats at an average 7 m/a.

066114
DAVIDSON-ARNOTT R, NICKLING W, FAHEY BD (ED) * **Research in glacial, glacio-fluvial, and glacio-lacustrine systems, Proceedings of the 6th Guelph Symposium on Geomorphology, 1980** (see chapter 6.3 for complete reference - voir chapitre 6.3 pour la reference complete)

062768
DAVIDSON-ARNOTT RGD, AMIN SMN * **Application of computer modelling and sediment budget techniques to shore erosion problems, S.W. Lake Ontario** . IN: Proc Canadian Coastal Conf 1983, Varcouver, 11-14 May 1983 * HOLDEN BJ * 253-267 * Natl Res Counc, Assoc Comm Res Shoreline Erosion Sediment, Ottawa, Ont K1A OR6 * 1983.

The area between Grimsby and Hamilton is

characterized by low till bluffs, narrow beaches, a scarcity of stable beach sediments, and recession rates in excess of 1.0 m per yr. Assessment of the impact of artificial structures in such areas requires considerable knowledge of littoral drift processes and sediment supply. In this study, sediment supply is determined as part of a sediment budget. A model of potential longshore sediment transport patterns and rates is determined from wave climate data and computer modelling of wave refraction. Comparison of sediment availability and potential transport permits identification of areas of sediment deficiency or surplus, and the approach provides a useful basis for assessment of the impact of structures.

F10594
DENIS R * **Detournement Eastmain-Opinaca-La Grande, etude de l'evolution biophysique du lit et des berges de la partie des rivieres Eastmain et Opinaca situee a l'aval des ouvrages de detournement (1980)** * Les consultants SOGEAM inc, Longueuil, Que * 1981-08.

Ce dossier photographique se veut un reflet des conditions biophysiques naturelles et de celles qui ont prevalu apres la coupure des debits (ete 1980) dans les portions des rivieres Eastmain et Opinaca situees a l'aval des ouvrages de detournement. Les photographies sont regroupees par zones homogenes au plan morpho-sedimentologique. En annexe des tableaux fournissent une description geomorphologique sommaire des rives naturelles et des rives affectees par le detournement, ainsi que des precisions quant aux superficies exondees et aux volumes de sediments erodes en fonction de l'abaissement moyen du niveau d'eau zones homogenes.

065178
DICKINSON WT * **Occurrence and control of soil erosion and fluvial sedimentation in selected basins of the Thames River watershed** (see chapter 7.2 for complete reference - voir chapitre 7.2 pour la reference complete)

066133
DILLON PJ, EVANS RD * **Whole-lake lead burdens in sediments of lakes in southern Ontario, Canada** , IN: Sediment/Freshwater Interaction, Proc 2nd Int Symp, Kingston, Ont, 15-18 June 1981 * Hydrobiologia * v91/92 121-130 * 1982-07-16.

The anthropogenic stable lead content of the sediments of eight softwater Precambrian lakes in southern Ontaro was measured at 34-92 sites per lake. Whole-lake anthropogenic lead burdens varied between only 610 and 770 mg per sq m. There was no relationship between lead burden and either water replenishment time of the lake (T sub W) or the ratio of watershed area to lake area (A sub d/A sub O), which varied by factors of 4 and 12 respectively. These results can be explained if a) the lead deposition in this region is uniform, and b) the only significant input of lead to the lakes is via deposition from the atmosphere directly on the lakes' surfaces. Therefore spatial differences in anthropogenic lead within a lake represent the redistribution or focusing pattern of the sediments.

062458
DIONNE JC * **A boulder-strewn tidal flat, north shore of the Gulf of St Lawrence, Quebec** * Geogr Phys Quat * 35(2) 261-267 * Presses Univ Montreal, Montreal, Que H3C 3J7 * 1981.

A clay flat strewn with ice-drifted boulders occurs in a sheltered embayment near Harrington Harbour, North Shore of the Gulf of St. Lawrence. The embayment, approx. 7 sq km in area with a slope gradient less than 0.2 degrees, is under the influence of tides ranging from 1.4 to 2.2 m and of a low wave energy regime. Ice entirely covers the flat during 3 to 4 months per year but may be present up to 5 months. Ice rafting, ice pushing, and ice gauging are moderately important processes in the embayment.

065777
DURGUNOGLU A, GER AM, YUCEL O * **Sediment sorting along a reservoir delta** , IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * v2 615-629 * Can Soc Civ Eng * (1983).

Nonuniformity of the mixture particle size distributions was shown to predominate the spread and sediment sorting characteristics along a reservoir delta, as computed by a backwater-type unidirectional-flow model using Einstein's total load relationship. The total amounts of deposition were found to remain the same for mixtures with the same median diameter but different particle size distributions. A typical feature of deltas for non-uniform mixtures was observed to be the formation of secondary deltas in the headwaters sections of the reservoir by the coarser sediments. Variations applied to channel geometry, on the other hand, appeared to produce relatively much less significant effects on the total amount of deposition as well as the main geometric features of the delta.

063633
DURHAM RW, OLIVER BG * **History of Lake Ontario contamination from the Niagara River by sediment radiodating and chlorinated hydrocarbon analysis** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

065483
DUTKA BJ, KWAN KK * **Microbiological examination of Lake Erie and Lake Ontario sediments** * Hydrobiologia * 98(2) 135-145 * 1983-01-23.

Diver collected cores from three sites in Lake Erie, west of Cleveland, Eastern basin and near Buffalo, and one from Lake Ontario near the mouth of the Niagara River, were sectioned to 20 cm and examined for sulfur cycle and nitrogen cycle bacteria, heterotrophic bacteria, insoluble organic and inorganic phosphate solubilizing bacteria and manganese oxidizing bacteria. Eh, pH, nitrogen, organic carbon and percentage moisture determinations were also made. Data from this study support and confirm other microbiological data collected from Lower Great Lakes sediment and also support the hypothesis that microbial flora of similar type sediments are numerically similar irrespective of the sediments source within the Lower Great Lakes.

062374
EL-SHAARAWI AH, DELORME LD * **The change-point problem for a sequence of binomial random variables** . IN: Time series methods in hydrosciences * EL-SHAARAWI AH, ESTERBY SR * 68-75 * Elsevier Sci Publ Co, Amsterdam, NL * 1982.

Three statistics are presented for detecting a change in a sequence of ordered binomial random variables. The first two are based on the conditional distribution of the random variables given their sum, while the third statistic is based on the empirical logistic transform approach. The use of these statistics is illustrated using data from a lake-sediment core.

062368
ELZAWAHRY AE, JAMES W * **Program TOTSED: transient sediment deposition and resuspension in a one-dimensional zone between an outfall and a receiving water, background theory** * Rep R79/80 * 81p * CHI Publ * 1982-02.

TOTSED is a program to predict the bed sediment and suspended sediment load as a function of time and distance along a one-dimensional quasi-steady receiving area. TOTSED used the modified Einstein approach for bed load calculations and the Einstein approach for suspended load calculations. The plug flow reactor is used for the inflow load (sediment pollutograph) calculations. TOTSED has been written as a new block of the SWMM package. TOTSED was verified and calibrated using data obtained from a sampling program carried out in the Chedoke Creek outfall channel in Cotte's Paradise in Hamilton during summer 1980. Similar computations were carried out using the HEC-6 program. TOTSED predictions compare favourably with both HEC-6 and the observed data. The report provides the background theory for the program. The TOTSED user's manual includes an application for the Chedoke Creek outfall channel.

062366
ELZAWAHRY AE, JAMES W * **Program TOTSED: transient sediment deposition and resuspension in a one-dimensional zone between an outfall and a receiving water, user's manual, including sample application** * Rep R79/80 * 111p * CHI Publ * 1982-02.

TOTSED is a program to predict the bed sediment and suspended sediment load as a function of time and distance along a one-dimensional quasi-steady receiving area. TOTSED uses the modified Einstein approach for bed load calculations. The plug flow reactor is used for the inflow load (sediment pollutograph) calculations. TOTSED forms a new block of the SWMM package. The model was verified and calibrated using data obtained from a sampling program carried out in Chedoke Creek outfall channel in Coote's Paradise in Hamilton during summer 1980. Similar computations were carried out using the HEC-6 program. TOTSED predictions compare favourably with both HEC-6 and the observed data. Further details are available in a companion report in The Background Theory for the program (May 1981).

063620
ENGEL P * **Sampling efficiency of the VUV bedload sampler** * 12p * Environ Can, Natl Water Res Inst, Inland Waters Dir * 1983-02.

Using dimensional analysis, the sampling efficiency of the VUV type bedload sampler was expressed in terms of flow condition, sediment properties, sampler geometry and sampling time. Existing data and new data obtained in a large sediment flume, using scale models of the sampler, were used to develop a calibration curve for this type of sampler. The data showed that the sampling efficiency decreases with the increase in the dimensionless trap number t (sub asterisk) U (sub asterisk) per L (sub C) (t (sub asterisk) = sampling time, U (sub asterisk) = shear velocity and L (sub C) = width of the sampler intake). Comparison of calibration curves for the VUV and WSC basket sampler showed that the shapes of the curves are similar, however, the sampling efficiency of the VUV sampler is always higher. Further tests are required to assess the effect of grain size on the sampling efficiency.

066864
ENGEL P * **Performance characteristics of the VUV bed load sampler** * NWRI Unpubl Manuscr No 84-5 * 13p * Environ Can, Natl Water Res Inst, Inland Waters Dir * 1983-10.

Dimensional analysis was used to express the sampler catch and sampling efficiency of the VUV type bed load sampler in terms of flow condition, sediment properties and sampler

geometry. Existing data and new data obtained in a large sediment flume, using a scale model of the half size VUV sampler, were used to examine the effects of the pertinent independent variables. The sampler catch was found to depend on four dimensionless variables whereas the sampling efficiency could be defined in term of one dimensionless variable. The sampling efficiency was found to vary from 60% to about 30% over the normal operating range.

062815
EVANS HE, SMITH PJ, DILLON PJ * **Anthropogenic zinc and cadmium burdens in sediments of selected southern Ontario Lakes** * Can J Fish Aquat Sci * 40(5) 570-579 * 1983-05.

The concentrations of Cd and Zn were measured in the sediments of 10 softwater lakes in southern Ontario. Elevated Cd and Zn levels were present in the recently deposited sediments of all the lakes, despite the absence of local point-source inputs. Whole-lake anthropogenic Zn and Cd burdens, calculated by prorating site-specific burdens according to the ratio of the site-specific Pb burden to the whole-lake Pb burden, range between 322 and 617 mg per sq m for Zn and between 6.2 and 11.3 mg per sq m for Cd. There were no significant differences in anthropogenic Zn or Cd burdens between lakes. The lack of a relationship between Zn or Cd burdens and the ratio of watershed area to lake area or the water replenishment time of the lakes indicates that deposition from the atmosphere directly onto the lakes' surfaces is an important input of these metals to the lakes.

062821
EVANS RD, RIGLER FH * **A test of lead-210 dating for the measurement of whole lake soft sediment accumulation** * Can J Fish Aquat Sci * 40(4) 506-515 * 1983-04.

We have tested the hypothesis that variation in accumulation of soft sediments over a lake bottom is related to the lake morphometry, allowing an accurate measurement of whole lake sediment accumulation. In each of two Laurentian Shield lakes in southern Ontario, sediment accumulation was measured at approximately 20 locations. In both there was a statistically significant linear relationship between soft sediment accumulation and the water depth at the sample locations. The relationship explained 72 and 57% of sediment accumulation variation in Costello and Red Chalk lakes, respectively. Using these relationships, it was possible to calculate the whole lake sediment accumulation rate for each lake. The results indicate that, in general, there is a linear variation in sediment accumulation as a function of depth in small Shield lakes. This study points out the need for a closer examination of sediment movement and accumulation in the shallow regions of lakes.

066376
GEARING JN, GEARING PJ * **Suspended load and solubility affect sedimentation of petroleum hydrocarbons in controlled estuarine ecosystems** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

062873
GHEBRE-EGZIABHIER K, ST ARNAUD RJ * **Carbonate mineralogy of lake sediments and surrounding soils 1. Blackstrap Lake** * Can J Soil Sci * 63(2) 245-257 * 1983-05

The carbonate mineralogy of the Blackstrap Lake sediments in central Saskatchewan indicates that the lake deposits are composed of carbonatic minerals similar to those found in surrounding soils and glacial deposits. Textural differences reflect the transport of finer materials (silts and clay) from the adjacent eroding landscapes. In particular the persistence of dolomite in the silt fractions of the lake sediment is a good indication that part of the calcite together with the dolomite are derived from sourrounding soils. The sediment sand fraction contains appreciable Mg-bearing calcite and mollusk shells of pure calcite. Changes in the ionic concentrations of the lake water indicate that dissolution-precipitation processes have affected sediment composition. The increased calcium carbonate equivalent percentages and the presence of secondary magnesium-bearing calcites in the lake sediments suggest that this is so, particularly since erosional processes could not account entirely for the differences observed between the sediments and surrounding soils. The presence of gypsum and the nature of the secondary calcites in the Blackstrap Reservoir sediment tie in well with the known historical background of the Reservoir. The increased ionic concentration of the lake water over the last 15 yr or so since the original inception of the Reservoir is attributed to the influx of drainage waters, evaporation and possibly the effects of groundwater entry from below.

F11913
GIDAS NK * **Recherche sur les meilleures solutions contre le probleme de sedimentation a l'embouchure de la riviere Nicolet** , IN: 6e Conf can d'hydrotechnique, comptes-rendus, 2-3 juin 1983, Ottawa, Ont * TOWNSEND RD * v2 631-650 * Soc can genie civ * 1983-06.

La sedimentation a l'embouchure de la riviere Nicolet (Quebec) a ete etudiee en vue de resoudre un probleme de navigation. La recherche sur les principales causes de la sedimentation et sur le mecanisme de transformation de l'embouchure de la riviere ainsi que les releves effectues sur le terrain et les analyses en laboratoire ont permis de

concevoir differentes solutions valables sur le plan technico-economique et environnemental. La solution retenue comprend des ouvrages de stabilisation des berges, des endiguements, un bassin de decantation des sediments et un dragage du chenal relativement restreint.

064886
GILBERT R, CHURCH M * **Contemporary sedimentary environments on Baffin Island, N.W.T., Canada: Reconnaissance of lakes on Cumberland Peninsula** * Arct Alp Res * 15(3) 321-332 * 1983-08.

Studies were made of four lakes receiving significant quantities of glacial sediment, and of five lakes receiving no glacial sediment. All waters contain less than 10 mg per L dissolved sediment, with highest values in the glacial lakes where ion scavenging can occur from fine suspended sediment. Zooplankton abundance and total carbon content of sediments are an order of magnitude higher in the nonglacial lakes. Shallow box cores were taken in order to study the recent sediments. Two depositional environments can be recognized, one dominated by physical processes with higher rates of clastic sedimentation, and one dominated by chemical processes, especially iron/manganese concentration. In the former, which occurs in both glacial and nonglacial lakes, periodic high sediment inflow associated with glacial or nival melt, or with summer precipitation, produces distinct laminae. Although they contain less than 10% sand, grading and load structures indicate that these beds were probably deposited from underflows or interflows in the lake. Iron bands containing up to 39% by weight iron form where sedimentation occurs. Despite a very pronounced difference between winter and summer inflow to the lakes, varves could not be recognized in any of the sediments.

065172
GRAHAM A, KNIGHT G * **Open drain improvement** * Stratford/Avon River Environ Manage Proj, Tech Rep R-6 * 24p * 1982-09.

Work began in the fall of 1980 on a major drain improvement demonstration carried out on the uppermost reaches of the Avon Municipal Drain in North Easthope Township. The work was initiated by the Stratford/Avon River Environmental Management Project in cooperation with two private landowners. Remedial measures undertaken on the drain included bottom cleanout, bank stabilization, improvement of tile outlets, buffer strips, fencing to control livestock access to the watercourse and the construction of a sediment basin. This report describes each of these measures except the livestock fencing and sediment basin construction which are described in Technical Reports R-7 and R-12 respectively. The combined impact of the conservation measures is aimed at reducing sediment loadings to the Avon River in a cost effective manner. Response to the demonstration work has been very favourable. Continued monitoring and inspection of the work will determine its long-term impact on water quality.

065849
GRAHAM A, KNIGHT G * **Sediment basin demonstration project** * Stratford/Avon River Environ Manage Proj Tech Rep R-13 * 22p * Ont Minist Environ and Minist Nat Resour * 1983-01.

An in-channel sediment basin was constructed on the Avon Municipal Drain, Lot 16, Con. II of North Easthope Township. This uppermost section of the Avon falls into the SAREMP'S Demonstration Sub-Watershed where a variety of remedial measures have been put into place over the three-year study period. The purpose of the sediment basin was to determine the costs and benefits of sediment basin construction in municipal drainage works with regard to reduced drain cleanouts and improved water quality. The basin constructed in November, 1980 at an approximate cost of $4000. Over the first two years of its operation, the basin has trapped 1031 cu yd of sediment. The demonstration project has been well received both locally and by visiting professional personnel. Continued monitoring of the basin's effectiveness will give a better indication of cleanout frequency and of the long-term effect on water quality.

066498
HUANG PM, OSCARSON DW, HAMMER UT, LIPINSKI NG, LIAW WK * **Dynamics of certain redox reactions of selenium in freshwater sediments** . IN: Proc 9th Annu Aquat Toxicity Workshop, 1-5 Nov 1982, Edmonton, Alta * MACKAY WC * Can Tech Rep Fish Aquat Sci 1163 * 97-103 * Fish Oceans Can, Fish Habitat Manage Branch, Ottawa, Ont K1A 0E6 * 1983-11.

The rates of certain redox reactions of Se (0,IV, VI) in two freshwater sediments (Katepwa and Buffalo Pound lakes) in Saskatchewan were studied. The appearance of Se(IV) in solution after a 72-hour reaction, when Se(VI) is the Se species initially added to the sediments, clearly indicates that the sediments have partially reduced Se(VI) to Se(IV). The concentrations of Se(IV) in solution after 7 weeks are 4-15% of the total Se remaining in solution. The rate of reduction of Se(VI) to Se(IV) appears to be related to E sub h and reducing components of the sediments. In the absence of sediments, no detectable Se(VI) is reduced to Se(IV) within 7 weeks. The transformation of Se(IV) to Se(VI) in the sediments is not detectable within 7 weeks. Selenium (0) is autooxidized to Se(IV) and then partially absorbed by the sediments. The conversion of Se(0,VI) to Se(IV) in freshwater sediment systems merits

close attention since Se species differ in their solubility and toxicity.

066138
HUANG PM, OSCARSON DW, LIAW WK, HAMMER UT * **Dynamics and mechanisms of arsenite oxidation by freshwater lake sediments** , IN: Sediment/Freshwater Interaction, Proc 2nd Int Symp, Kingston, Ont, 15-18 June 1981 * Hydrobiologia * v91/92 315-322 * 1982-07-16.

There has been increasing concern over As in freshwater environments from sources such as arsenical pesticides, smelters, coal-fired power plants, and erosion caused by intensive land use. Arsenic in the reduced state, AS(III)(arsenite), is much more toxic, more soluble and mobile, than when in the oxidized state, As(V)(arsenate). This paper summarizes the dynamics and mechanisms involved in the oxidation of As(III) to As(V) by freshwater lake sediments. Sediments from selected freshwater lakes in southern Saskatchewan oxidize As(III) to As(V) predominantly through an abiotic process. Solution analysis of As(III) and As(V) by colorimetry, and examination of the oxidation state of surface-sorbed As species by X-ray photoelectron spectroscopy, indicate that Mn present in the sediment is the primary electron acceptor in the oxidation of As(III). The transformation of As(III) to As(V) by carbonate and silicate minerals, common in sediments, is not evident. The heat of activation, delta H sub a, for the depletion (oxidation plus sorption) of As(III) by the sediments, varies from 3.3 to 8.5 kcal per mole, indicating that the process is predominantly diffusion-controlled. The Mn present in a series of particle size fractions of the sediments may potentially detoxify As(III) in aquatic systems, by converting it to As(V).

065762
HUDSON HR * **Evaluation of selected bed load formulae in a steep, gravel bed river** , IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * v1 331-356 * Can Soc Civ Eng * (1983).

Guidelines for the selection and application of appropriate sediment transport formulae are not available for gravel bed rivers. Criteria for evaluating and modifying bed load formulae are proposed and several formulae are tested against the revised bed load data from the Elbow River at Bragg gauge, and from three other sites on the Elbow River, where bed load had recently been measured with a Helley-Smith bed load sampler. Some frequently used formulae are totally unsuitable, whereas others can be modified to adequately describe the mean capacity bed load. However, no formula can describe the mean capacity bed load at all points in the system.

062765
HUNTLEY DA * **In situ sediment monitoring techniques: a survey of the state of the art in U.S.A.** , IN: Proc Canadian Coastal Conf 1983, Vancouver, 11-14 May 1983 * HOLDEN BJ * 151-165 * Natl Res Counc, Assoc Comm Res Shoreline Erosion Sediment, Ottawa, Ont K1A OR6 * 1983.

This report discusses the results of a survey of fast-response, in situ sensors for measuring suspended and bedload sediment in the wave-dominated nearshore zone. The instruments considered are either optical, acoustic or impact sensors. We conclude that several sensors show promise for measuring suspended sediment transport. In fact, since the sensitivity of the optical and acoustic sensors to different particle sizes is very different, there is some hope that comparison of their outputs could provide a direct measure of sediment size as well as concentration. Disappointingly, there are no fast-response sensors capable of measuring bedload transport.

065597
JAMES W, EL ZAWAHARY A * **Algorithm for sediment deposition and resuspension in a one dimensional zone between an outfall and a receiving water** , IN: Proc Stormwater Management Model (SWMM) Users group meeting, Jan 19-20, 1981, Austin TX * 158-170 * McMaster Univ * 1981.

A mathematical model to predict bed and suspended sediment loads as a function of time and distance along a one-dimensional receiving area is described. The model, called TOTSED, uses the modified Einstein approach for bed load calculations and the Einstein approach for suspended load calculations. The plug flow reactor (PFR) is used for calculating sediment pollutographs along the one-dimensional area. The model was verified and calibrated using data obtained from a sampling program carried out in the Coote's Paradise outfall channel of the Chedoke Creek in Hamilton during summer 1980. Similar computations were also carried out using the HEC-6 program. TOTSED predictions compare favourably with both the observed data and the HEC-6 output.

066460
KARANKA EJ, HAWTHORN RS, CHAMBERLIN TW * **The application of British Columbia aquatic inventory data to channel stability evaluation** , IN: Acquisition and Utilization of Aquatic Habitat Inventory Information, Proc of a Symposium, 28-30 October, 1981, Portland, OR US * ARMANTROUT NB * 47-53 * Am Fish Soc, West Div * (1982).

Several methodologies for evaluating channel stability have been applied in British Columbia utilizing the British Columbia Aquatic Data Base for storage and processing of inventory information. United States

Forest Service channel stability ratings are stored in a separate file coordinated with the B.C. Aquatic Data Base. Channel stability ratings similar to the U.S.F.S. ratings have also been developed from the B.C. Aquatic System Data Base.

066136
KLAPWIJK A, SNODGRASS WJ * **Experimental measurement of sediment nitrification and denitrification in Hamilton Harbour, Canada** , IN: Sediment/Freshwater Interaction, Proc 2nd Int Symp, Kingston, Ont, 15-18 June 1981 * Hydrobiologia * v91/92 207-216 * 1982-07-16.

This research examines the role of sediment nitrification and denitrification in the nitrogen cycle of Hamilton Harbour. The Harbour is subject to large ammonia and carbon loadings from a waste-water treatment plant and from steel industries. Spring ammonia concentrations rapidly decrease from 4.5 to 0.5 mg per l, while spring nitrate concentratons increase from 1 to 2 mg per l, by mid-summer. A three-layer sediment model was develped. The first layer is aerobic; in it, oxidation of organics and nitrification occurs. The second layer is for denitrifcation, and the third layer is for anaerobic processes. Ammonia sources for nitricication include diffusion from the water column, sources associated with the oxidation of organics, sources from denitrification and from anaerobic processes. Diffusion of oxygen, ammonia and nitrate across the sediment-water interface occurs. Temperature effects are modelled using the Arrhenius concept. A combination of zero-order kinetics for nitrate or ammonia consumption with diffusion results in a half-order reaction, with respect to the water column loss rate to sediments. From experimental measurement, the rate of nitrification is 200 mg N per l sediment per day, while that of denitrification is 85 mg N per l sediment per day at 20 C. The Arrhenius activation energy is estimated as 15 000 cal/mole-K and 17 000 cal/mole-K for nitrification and denitrification, respectively, between 10 C and 20 C. Calculations of the flux of ammonia with the sediments, using the biofilm model, compare favourably with experimental observations. The ammonia flux from the water column is estimated to account for 20% of the observed decrease in water column stocks of ammonia, while the nitrate flux from the water column is estimated to account for 25% of the total nitrogen produced by the sediments.

063324
KRISHNAPPAN BG * **Modelling of unsteady flows in alluvial streams** (see chapter 4.1 for complete reference - voir chapitre 4.1 pour la reference complete)

062920
KRISHNAPPAN BG * **Suspended sediment profile for ice-covered flows** * J Hydraul Eng * 109(3) 385-399 * 1983-03.

The vertical distribution of the suspended sediment in two-dimensional, uniform, and fully developed turbulent flows under ice cover is formulated using the results of the kinetic energy-rate of dissipation turbulence model of Launder and Spalding. Three sets of distribution curves each corresponding to a particular value of the ratio between the ice cover roughness and bed roughness are presented in a form simular to the distribution curves of H. Rouse for free-surface flows. For the same value of the ratio between the shear velocity and the fall velocity of sediment particles, the relative concentration is less in ice-covered flows than in free-surface flows. Under similar conditions, the relative concentration of suspended sediment decreases as the ratio of the ice cover roughness to bed roughness increases. The agreement between the present formulation and the measurements found in the literature is favorable.

063639
KUNTZ KW, WARRY ND * **Chlorinated organic contaminants in water and suspended sediments of the lower Niagara River** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

062393
LAM DCL, SCHERTZER WM, FRASER AS * **Mass balance models of phosphorus in sediments and water** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

065466
LAST WM, SCHWEYEN TH * **Sedimentology and geochemistry of saline lakes of the Great Plains** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

062898
LAU YL * **Suspended sediment effect on flow resistance** * J Hydraul Eng * 109(5) 757-763 * 1983-05.

A general velocity distribution consisting of a logarithmic profile plus a wake function has been used to investigate the effect of suspended sediment on flow resistance. From the experimental evidence that the wake constant increases when sediment is in suspension, it is shown that flow resistance must be reduced. It is shown that a flow with suspended sediments should have lower velocities near the boundary and higher velocities further away from the boundary than a clear water flow, given that the discharge

and slope are identical.

066044
LAWRENCE M, PELLETIER BR, LACHO G * **Sediment sampling of beaches along the Mackenzie Delta and Tuktoyaktuk Peninsula, Beaufort Sea** , IN: Current Research, Part A, * Geological Survey of Canada, Paper 84-1A * 633-640 * 1984.

Sixteen representative beaches along the southeastern Beaufort Sea are described and illustrated from the standpoint of morphology, erosion, and sediment transport. This is part of a larger fisheries research program (Department of Fisheries and the Oceans) which is designed to gain information on the sensitivity of these beaches to erosion and oil contamination. Detailed textural analysis on 46 beach samples reveals the undercutting action of waves on shore cliffs that are undergoing thermal degradation and slumping. Fine sediment is removed by the waves and transported easterly by oceanic longshore currents towards Amundsen Gulf or to local sediment sinks lying east or west of the beach source. A strong beach armour of coarse pebbles, cobbles, and a few boulders characterizes most beaches on the mainland. Beaches on the barrier islands are mainly sand. Removal of beach armour should be prevented, and finer granular material should be removed with utmost precaution, particularly in those areas where replenishment is slow or perhaps where the loss cannot be replaced by wave action or longshore currents.

064860
LAZERTE BD * **Stable carbon isotope ratios: implications for the source of sediment carbon and for phytoplankton carbon assimilation in Lake Memphremagog, Quebec** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

066122
LECKIE DA, MCCANN SB * **Glacio-lacustrine sedimentation on low slope prograding delta, chapter 12** , IN: Research in glacial, glacio-fluvial, and glacio-lacustrine systems, Proc 6th Guelph Symp on Geomorphology, 1980 * DAVIDSON-ARNOTT R, NICKLING W, FAHEY BD * Dep Geogr, Univ Guelph Geogr Publ No 6 * 261-278 * Geo Books, Regency House, 34 Duke St, Norwich NR3 3AP, GB * 1982.

Well exposed sections of lacustrine sediments at Conne River, southern Newfoundland, provide a basis for the development of a model of glaciolacustrine sedimentation in a recessional, valley glacier environment. Three distinct lithological units occur: a lower unit of thin, parallel-bedded, very fine sands, silts and clays; a middle unit of ripple cross-laminated and massive sands interbedded with clayey-silts; and an upper unit of poorly sorted, structureless sands and gravels with crude horizontal stratification. The lower unit represents lake bottom sediments emplaced by two sets of processes. The finely laminated silts were deposited out of suspension from sediments introduced into the lake by inter- and over-flow currents, and the sharp-based, graded beds were deposited by turbidity currents. The sands of the middle unit were deposited on the front of a low slope, prograding delta, subject to slump-induced grain flows. During quiet intervals, finer material settled out of suspension, and a seasonal periodicity is inferred from the couplets of sand and clayey-silt which are present. The coarse upper unit represents the proximal, glaciofluvial, topset beds of the advancing delta. The depositional processes recognized in the sediments suggest a refinement of the existing models of glaciolacustrine sedimentation to incorporate situations where a low slope, prograding glaciofluvial delta advances over glaciolacustrine sediments.

062473
LEE GF, JONES RA * **Assessing environmental impacts of open water disposal of dredged sediment** * World Dredg Mar Constr * 18(4) 20-22 * 1982-04.

This paper summarizes the current state of knowledge on some aspects of the environmental impacts of dredged sediment disposal in the United States and describes how this knowledge has been incorporated into U.S. Environmental Protection Agency's 404 guidelines regulations governing dredged sediment disposal. The elutriate test, designed to estimate the amounts of contaminants that would be released to the sediment/water slurry during hydraulic hopper-dredge dredging, is evaluated as a substitute for bulk sediment criteria, and a modification of the test, the Plop Test, is recommended. The bioassay procedures, designed to determine the potential for toxicity associated with the deposited dredged sediments, are evaluated and a bioassay screening test employing only one type of organism instead of several different organisms, is recommended before proceeding with more complex and costly procedures. Problems associated with the December 1980 US EPA revised 404 Guidelines are described, including the approach suggested for asscssing the significance of contaminant release during the elutriate test. The use of a specific hazard assessment is urged to evaluate the potential environmental impact of open water disposal of dredged sediments.

066380
LEE RF, RYAN C * **Microbial and photochemical degradation of polycyclic aromatic hydrocarbons in estuarine waters and sediment** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference

complete)

066632
LUTERNAUER JL, LIAM FINN WD * **Stability of the Fraser River Delta front** * Can Geotech J * 20(4) 603-616 * 1983-11.

The distributary front deposits of the delta consist mainly of interlayered sand and silt and lie in one of the most seismically active zones in Canada. Subsurface deposits at the north tend to be siltier than those at the south. Sediments on the surface of the delta slope range from clayey silts at the north to pure sands at the south. Slope angles vary from 23 degrees at the head of the slope to 1-2 degrees within 2 km beyond the tidal flats. Hydraulic bedforms observed on the sandy slopes southeast of the main channel gradually increase in size from small ripples to large asymmetric sand waves 2-3 m high and approximately 30 m long. They are generated primarily by flood tidal currents which scour the seabed to a water depth in excess of 100 m. Formation of gullies which crease the delta slope probably is initated principally by failure of oversteepened deposits at a channel mouth. Previous studies have suggested that the large hummocks or ridges at the base of the slope off the Main Channel have been formed by the compressional folding of failed deposits. Recent reflection seismic surveys suggest that such a process has recurred in this area during the growth of the delta. Interpretation of SPT data, in the light of recent research findings, suggests that previous analyses have overestimated failure potential. It is estimated that the slope may withstand an earthquake with a duration corresponding to approximately 15 significant cycles of motion and a peak acceleration in the range of 11-13% G.

066827
MARTEC LTD * **Annapolis Tidal Power Project settling basin conceptual design** * 13p * Martec Ltd, 1526 Dresden Row, Halifax, NS B3J 3K3 * 1980-04-16.

This report presents a short description including layout drawings and flow diagrams of the proposed pit water settling basin near the Annapolis barrage. The consulting firm suggests that the proposed design should remove about 95% of the material entering the Basin, and should satisfy the demands of the Nova Scotia Department of the Environment. A table providing the size, retention time, theoretical percent removal and the volume settled per day for each of the three ponds is also included in the report.

F12174
MATHIER L, ROY AG * **Variations de la forme des versants le long d'un cours d'eau miniature** * Geogr phys quaternaire * 38(1) 81-86 * Les Presses de l'Univ Montreal * 1984.

Le long du cours d'eau principal d'un bassin-versant miniature, la forme des versants est en partie controlee par l'exposition et la distance de l'embouchure. Les versants exposes au SE sont plus raides, plus courts et comportent moins de segments rectilignes que ceux exposes au NW. Par contre, l'angle des versants n'augmente ni ne diminue de la tete du cours d'eau vers l'embouchure. Les versants convexes a l'amont deviennent brusquement concaves a l'aval. Ce changement morphometrique s'effectue a l'endroit ou le cours d'eau cesse de s'inciser activement.

F11221
MCCART PJ, CROSS PM, GREEN R, MAYHOOD DW, TSUI PT, MCCART PJ, GREEN RH * **Effets de l'envasement sur l'ecologie du lac Ya-Ya, T.N.-O.** *Etude environnementale no 13 * 226p * Minist aff indiennes et du Nord Can, Ottawa, Ont * 1981.

L'envasement est sans doute la perturbation environnementale la plus courante des habitats aquatiques, provoquee par les activites de mise en valeur du Nord. Le lac Ya-Ya sur l'ile Richards, dans le delta du Mackenzie, (Territoires du Nord-Ouest) a ete choisi comme site d'etude des effets de la charge des sediments en suspension sur les ecosystemes des lacs. L'objectif principal de l'etude etait de determiner les consequences de la sedimentation sur divers niveaux trophiques, notamment les poissons, dans le cadre d'un ecosysteme de lac boreal. D'autres objectifs connexes consistaient a elaborer, d'apres les resultats de l'etude, un modele permettant de mieux prevoir et quantifier l'impact de l'envasement sur les ecosystemes des lacs dans le Nord et a proposer des criteres quantitatifs definissant les niveaux de sedimentation acceptables, lesquels pourraient etre utilises dans la reglementation des projets de developpement dans le Nord. Les difficultes rencontrees dans l'application des resultats sont evaluees dans les conclusions.

062766
MCLAREN WA, BUCKINGHAM WR * **Sand movement study on Fraser River foreshore** . IN: Proc Canadian Coastal Conf 1983, Vancouver, 11-14 May 1983 * HOLDEN BJ * 217-233 * Natl Res Counc, Assoc Comm Res Shoreline Erosion Sediment, Ottawa, Ont K1A OR6 * 1983.

Sediment movement studies were conducted over Roberts Bank and Sturgeon Bank on the Fraser River foreshore using sand samples dyed with Rhodamine WT. The sand was collected, dyed and replaced at 9 study sites prior to and during the Fraser River freshet period. Sand movement was correlated to concurrent wind and tidal current records. Sand tracers on the north part of Sturgeon Bank showed little movement. Movement on the south part of Sturgeon Bank was primarily due to wave action at low tide on the outer foreshore area and to

tidal action near shore. Movement on Roberts Banks was due primarily to tidal and river discharge action with a maximum rate of 0.35 m/day.measured near Canoe Pass.

066090
MILES MJ, KELLERHALS R * **Some engineering aspects of debris torrents** . IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * v1 395-420 * Can Soc Civ Eng * (1981).

Debris torrents are a form of mass movement involving the rapid flow of boulders, soil, and forest debris down through well established, steep stream channels. Their occurrence depends on a combination of steep slopes, high intensity runoff events and a ready source of debris, conditions frequently found along the West Coast of British Columbia. Many of the small, steep tributaries to the major rivers cutting across the Coast Mountains are naturally subject to debris torrent events at reasonably regular intervals, which might range from a few years to centuries. Logging can greatly increase the frequency of such events. The engineering significance of debris torrents is primarily associated with two of their features, (i) the extremely large size and volume of material moved, which will not normally fit through culverts or under small bridges and (ii) the great lateral instability of debris torrents in their runout and accumulation zone. Standard procedures for designing stream crossings based on flood frequency considerations become inapplicable, as do conventional flood plain mapping procedures. An extensive literature on debris torrents exists in the field of forestry and is reviewed briefly. Case histories from B.C. are introduced and several engineering solutions are discussed in the context of suggested general design criteria.

063629
MUDROCH A * **Distribution of major elements and metals in sediment cores from the western basin of Lake Ontario** * J Great Lakes Res * 9(2) 125-133 * 1983.

An investigation was made of the relationship between the changes in metal concentrations in sediments with the distance from the Niagara River mouth and the chemical and physical characteristics of the sediments. Sediment cores were obtained at nine sampling stations in the western basin of Lake Ontario. In addition, surface sediment was collected at three stations on the Niagara Bar. Minerals present at all stations were silica, feldspars, illite/muscovite, chlorite, kaolinite, and calcite. Dolomite was found at some sampling stations as grains of 2 to 63 micro m size. Significantly elevated concentrations of calcite (up to 20%) in the surface sediment (about 0 to 10 cm) at four sampling stations in the western basin and in the entire 25-cm sediment column at the Niagara River mouth indicated increased input of this mineral into Lake Ontario during the past 100 years. Furthermore, sediment concentration profiles of Zn, Pb, Cr, Cu, Ni, and especially Hg at all sampling stations indicated major transport of metals associated with the clay- and silt-size particles from the Niagara River into Lake Ontario (especially north-north-east and east of the river mouth). A significant decrease in Hg loading from the Niagara River during the past 20 years was also observed. Although smaller in magnitude, a similar decrease was found for Pb, Zn, Cr, Ni, and Cu loading. However, elevated Hg concentrations (up to 7 micro g per g above background values) existed in the surface 10 cm of sediment at eight sampling stations.

062332
MUDROCH A, ZEMAN AJ, KALAS LL * **Calcium carbonate in postglacial Lake Erie sediment** * J Great Lakes Res * 8(4) 711-718 * 1982.

Geotechnical, geochemical, electron-microscopic and biostratigraphic investigation of a 16.8-m long core of a postglacial lacustrine mud collected from the central Lake Erie basin revealed zones containing up to 30% calcite. These zones were associated with a very fine sediment, 80% of which was finer than 4 micro m. Shear strength values of the sediment ranged from 2 kN/sq m near the lake bottom to about 9 kN/sq m close to the Pleistocene boundary. The concentration of CaO was positively correlated with the concentration of inorganic C and Sr. The concentration of SiO2, A1203, Fe203, K20, and Rb gradually decreased with depth. The major crystalline phases were illite (44 wt%), chlorite (10 - 13 wt%), calcite (6 - 30 wt%), quartz (6 - 20 wt%), albite (6 - 9 wt%), K-feldspar (2 wt%), and dolomite (2 wt%). The shells of mollusc species present in the lower portion of the postglacial sedimentary column indicated that the carbonate-high sediments were deposited in warmer water than the carbonate-low sediments above and between them.

066141
NEAME PA, DEAN JR, ZYTARUK BG * **Distribution and concentrations of naturally-occurring radionuclides in sediments in a uranium mining area of northern Saskatchewan, Canada** . IN: Sediment/Freshwater Interaction, Proc 2nd Int Symp, Kingston, Ont, 15-18 June 1981 * Hydrobiologia * v91/92 355-361 * 1982-07-16.

Uranium mining and milling operations can contribute to environmental degradation through the increased release of naturally-occurring radionuclides. However, studies of the interactions of these radionuclides with freshwater sediments have been limited. The present study examined the vertical distribution of uranium, thorium, radium-226,

polonium-210 and lead-210 in undisturbed sediment cores collected in the vicinity of mining, milling and exploration activities. Uranium levels in surface sediments ranged from 1.9 to 5650 micro g per g. Ra-226 from less than 0.1 to 480 pCi per g and Pb-210 from 0.8 to 931 pCi per g in the samples reported here, with the highest values occurring downstream of waste rock disposal areas. Concentratons usually decreased with depth, and there was little evidence of any strong effect of bioturbation on radionuclide profiles at the scale examined here. Mathematical models of uranium and radium-226 adsorption on and movement into the sediment were constructed, based on expected adsorption coefficients and estimated loading. The model predictions of radionuclide distribution with depth were qualitatively similar to those actually measured, but the predicted concentrations were generally lower than those observed, both in unaffected areas and in areas adjacent to uranium extraction activities.

064898
NRIAGU JO, WONG HKT, SNODGRASS WJ * **Historical records of metal pollution in sediments of Toronto and Hamilton harbours** * J Great Lakes Res * 9(3) 365-373 * 1983.

The sediments of Hamilton and Toronto Harbours contain some of the oldest records of metal pollution in the Great Lakes basin. The fluxes of Cd, Cr, Cu, Ni, Pb, Zn Fe, and Mn into the two harbours have been estimated from the analyses of core samples dated by the Pb-210 technique. The contrasting metal levels in the two harbour sediments are viewed in relation to the differences in the disposal strategies of the dredged spoils and the sources of metal pollution in the harbours. The Zn and Fe concentrations of 5 to 8 mg per g and 10 to 13% dry wt. in Hamilton Harbour sediments, which are among the highest recorded in any harbour, can be related to effluent discharges from the large local iron and steel plants. An inventory of the sources and sinks of pollutant metals in Hamilton Bay shows a substantive export of the metals to Lake Ontario.

064884
OLIVER BG, KELSO JRM * **A role for sediments in retarding the acidification of headwater lakes** (see chapter 4.16.4 for complete reference - voir chapitre 4.16.4 pour la reference complete)

062381
OLIVER BG, NICOL KD * **Chlorobenzenes in sediments, water, and selected fish from lakes Superior, Huron, Erie, and Ontario** * Environ Sci Technol * 16(8) 532-536 * 1982-08.

Chlorobenzene (CB) concentrations have been measured in sediments, water, and fish from Lakes Superior, Huron, Erie, and Ontario. In addition, CB concentrations in the Grand and Niagara Rivers, in four sewage-treatment plant effluents, and in three drinking water samples have been determined. In general, CB concentrations in the water samples were low, less than 1 ng/L except in effluents and near point sources. The CB concentrations in sediments were quite low in Lakes Superior, Huron, and Erie, but much higher in Lake Ontario. Major sources of CB's to Lake Ontario appear to be chemical waste dump leachates and direct chemical manufacturing effluents located mainly around Niagara Falls, NY. Data from sediment cores indicate that CB contamination of Lake Ontario began about 40 years ago. A limited number of fish have been analyzed: Lake Ontario lake trout contain higher concentrations of CB's than fish from the other three lakes.

063631
ONUSKA FI, MUDROCH A, TERRY KA * **Identification and determination of trace organic substances in sediment cores from the western basin of Lake Ontario** * J Great Lakes Res * 9(2) 169-182 * 1983.

A study was carried out to identify and to determine organic chemicals in sediment from the western basin of Lake Ontario, particularly in the fine-grained sediments near the mouth of the Niagara River. Sediment cores were obtained at five sampling stations, and samples were extracted by the base/neutral and acid method designed by US Environmental Protection Agency for extraction of water samples. The identification of organic compounds in the base/neutral sediment extract was carried out by GC/MS techniques. The major classes of investigated contaminants were aromatics, polynuclear aromatics, alkylated polynuclear aromatics, alkylated benzenes, phthalates, methylesters of fatty acids, olefins, aldehydes, chlorobenzenes, and benzoates. In addition, all sediment samples were analyzed for 2,3,7,8-tetrachloro dibenzo-p-dioxin. In the surface sediments, the abundance of contaminants decreased with the distance from the Niagara River mouth toward the north-west. However, high concentrations of most of the detected organics were present in sediment at the station located east of the River mouth.

064410
OSCARSON DW, LIAW WK, HUANG PM * **The kinetics and components involved in the oxidation of arsenite by freshwater lake sediments** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

066601
PARKER G * **Scour in coarse-bedded streams** * Uned Mater OF 47 * 91p * Alberta Environ, Res Manage Div * 1981-01.

This report summarizes methods of predicting four types of scour in the gravel-bed streams: scour at the confluence of anabranches in braided streams, scour at long constrictions, bend scour, and scour due to alternate bars. The arbitrary division of scour into these four types is not intended to imply that there are no other common types of scour in gravel streams. For example, degradational scour and scour at bridge piers are not treated at all herein. The four types treated cannot always neatly be distinguished from each other. Bend and alternate bar scour are closely related, as they are manifestations of the tendency of rivers to meander. Braid confluences are usually also constrictions, and resemble bends in some ways. However, the distinction between the various types provides a mechanistically well-founded classification system, and, as such, should prove useful. Section 1 is devoted to a study of braid confluence scour. A comprehensive literature summary is provided, but most of the paper is devoted to the original results obtained by the author at the University of Alberta. Section 2 is devoted to scour in long constrictions, and in particular the role of pavement. Again, original experimental results of the author are presented, along with a literature review. Section 3 consists of a literature survey of bend and bar scour, with emphasis on data for gravel-bed streams. Each chapter is a self-contained unit, with its own references, figures, and page numbers, starting from one. Lest this make it difficult to locate the various chapters, noté that Chapter 1 consists of 42 pages, after which immediately follows Chapter 2. Chapter 2 consists fo 37 pages, with Chapter 3 immediately following.

F10972
POITEVIN J * **Etudes sedimentologiques: proposition d'une methode en vue de quantifier le cycle annuel d'erosion-sedimentation sur le territoire de la Baie James** * 67p * Soc energie de la Baie James, Montreal, Que * 1982-09.

A la suite des etudes entreprises sur le processus de sedimentation dans le secteur de la Baie de Rupert (1980-1981), il s'est avere necessaire de mettre sur pied une methodologie pour determiner les variations saisonnieres et annuelles de la dynamique sedimentologique des estrans. Ce rapport de stage se veut un survol des differentes techniques et methodologies associees a la dynamique sedimentologique rencontree dans la litterature.

066091
PRASUHN AL * **Modelling scour at highway bridges due to debris accumulation** . IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * vi 423-442 * Can Soc Civ Eng * (1981).

The Corps of Engineers computer program, HEC-6, has been chosen to model the effects of debris accumulation at a bridge on the backwater upstream of the bridge and the scour at the bridge itself. Modifications to the basic program included expending the range of sediment sizes, introducing additional transport functions, incorporating a bridge hydraulics routine, and adding pier scour equations. Each of these is discussed and verification runs are evaluated. Debris accumulation at a bridge crossing is simulated by lowering the low chord of the bridge andor increasing the pier width. A series of trapesoidal and rectangular channels with sand, gravel, and cobble beds are crossed by a bridge either with or without piers. A sequence of constant discharges or a flood hydrograph is passed through the model and the water surface and stream bed profile are evaluated for the different types and amounts of debris buildup. The model is considered to satisfactorily simulate the various effects of debris accummulation. This debris accumulation is found to have a significant impact on both the bridge backwater and the scour at the bridge.

062004
QUICK MC * **Sediment transport by waves and currents** * Can J Civ Eng * 10(1) 142-149 * 1983-03.

Sediment transport is measured under the combined action of waves and currents. Measurements are made with currents in the direction of wave advance and with currents opposing the wave motion. Theoretical relationships are considered that predict the wave velocity field and the mass transport velocity for zero current and for steady currents. Following Bagnold's approach, a transport power relationship is developed to predict the sediment transport rate. Making assumptions for the mass transport velocity, the transport power is shown to agree with the measured sediment transport rates. It is particularly noted that the sediment transport direction is mainly determined by the direction of wave movement, even for adverse currents, until the waves start to break.

064407
RATHKE DE, BLOESCH J, BURNS NM, ROSA F * **Settling fluxes in Lake Erie (Canada) measured by traps and settling chambers** . IN: International Association of Theoretical and Applied Limnology, Proceedings, JP, 1980 * SLADECEK V * 21(1) 383-388 * E Schweiz Verlagsbuchhandlung, D-7000 Stuttgart 1, DE * 1981.

This investigation, conducted in the Eastern Basin of Lake Erie during the summer of 1978, compares the detrital particles settling velocities as measured by both the sediment trap and settling chambers. Differences between the two experimental

methods in the calculation of sinking velocities and settling fluxes, are described. Mean settling fluxes measured with the traps are found to be higher in the hypolimnion and lower in the epilimnion than the fluxes measured by the chambers. Sinking velocities within the hypolimnion are similar as measured by both techniques, but significantly different in the epilimnion in that, measured with the traps, it was less than measured by the chambers. Reasons for the discrepancies are discussed with the major factors contributing to the differences specifically delineated. The high effects of resuspension (hypolimnion) and mineralization (epilimnion) in the traps of Lake Erie are discussed.

066137
REYNOLDSON TB, HAMILTON HR * **Spatial heterogeneity in whole lake sediments - towards a loading estimate** . IN: Sediment/Freshwater Interaction, Proc 2nd Int Symp, Kingston, Ont, 15-18 June 1981 * Hydrobiologia * v91/92 235-240 * 1982-07-16.

Studies of nutrient loadings, to shallow culturally eutrophied Alberta lakes, suggest internal inputs are significant. In this regard, estimation of bottom sediment P loads to Lake Wabamun (80 sq km, 5.5 m (x bar) depth) were examined. Initially we determined the spatial variability in Total Organic Content (% loss on ignition) and Total Phosphorus, as indicators. Phosphorus fractions and biologically available phosphorus (BAP) were measured at specific stations. These data showed a very uniform distribution in sediment type with a Total Organic Content of 40.6 plus or minus 3.3 (95% C.L.) at the west end, gradually declining to 26.3 plus or minus 0.9 at the east end. Transects performed at routine monitoring stations indicate the representativeness of each station, e.g., station 2.40.8 plus or minus 1.3 (10 sites). One explanation of this uniformity is provided from 210Pb analysis of shallow cores which indicate mixing to a depth of 16 cm. This is also thought to explain the mechanics of P loading to the water phase. Finally, Total Organic Content relates well to BAP (r sq = 0.80). It is hoped that this simple technique may well permit more precise extrapolation to whole lake BAP estimates at least on this lake.

066123
RINGROSE S * **Depositional processes in the development of eskers in Manitoba, chapter 6** . IN: Research in glacial, glacio-fluvial, and glacio-lacustrine systems, Proc 6th Guelph Symp on Geomorphology, 1980 * DAVIDSON-ARNOTT R, NICKLING W, FAHEY BD * Dep Geogr, Univ Guelph Geogr Publ No 6 * 117-137 * Geo Books, Regency House, 34 Duke St, Norwich NR3 3AP, GB * 1982.

In an attempt to arrive at a comprehensive theory for the origin of eskers, different eskers occurring in northern, central and southern Manitoba are compared in terms of morphology and sedimentology. Northern eskers, which occur as continuous ridges in subparallel swarms are longer, higher, and narrower than southern eskers which occur relatively infrequently, in beads which are shorter, lower and wider. Nineteen major facies types are identified and interpreted relative to the current literature on closed conduit and open channel bedform types. This, used in conjunction with vertical, lateral and downstream facies relationships, provides evidence to suggest that the northern eskers are produced primarily by surges of sediment deposited in heterogeneous suspension in a closed tunnel, whereas central and southern eskers (where observed) are the products of braided stream, open channel environments. The different types may be related to the prevailing ice regime with southern, beaded eskers being formed initially in the relatively narrow ablation zone at the margin of a 'polar' ice sheet, which may have become inactive during the later (observed) stage of esker deposition. The northern Leaf Rapids esker is thought to have been probably formed under active ice during more temperate conditions, where rapid melt and ice movement cause sliding bed conditions in vertical tunnels.

066142
ROBBINS JA * **Stratigraphic and dynamic effects of sediment reworking by Great Lakes zoobenthos** , IN: Sediment/Freshwater Interaction, Proc 2nd Int Symp, Kingston, Ont, 15-18 June 1981 * Hydrobiologia * v91/92 611-622 * 1982-07-16.

Recent sediments of the North American Great Lakes are inhabited by numerous species of macrobenthos which alter the physical and chemical properties of sediments and modify interface transport characteristics. Distributions of such radionuclides as cesium-137, lead-210, and isotopes of plutonium exhibit a zone of constant activity extending down from the sediment-water interface from 1 to 15 cm. Recent studies have confirmed that radiometrically determined mixed depths are consistent with the vertical distribution of oligochaete worms and the amphipod, Pontoporeia hoyi. Generally, 90% of the benthos are contained within the radiometrically defined mixed zone. Where comparisions are possible, rates of sediment reworking by 'conveyor belt' species are comparable to or exceed sedimentation rates. Systematic variations in the mixed depth occur within depositional basins with greatest depths tending to be associated with least consolidated, organically rich materials. A quantitative steady-state mixing model accounts satisfactorily for observed radioactivity and heavy metal profiles. Bioturbation appears to be an important process, limiting the resolution with which

historical records of particle-associated contaminants may be reconstructed from sediment cores. As bioturbation serves to maintain contact of contaminated sediments with overlying water, this time may also characterize the long-term lake recovery for contaminants removed by burial. As the time varies with location, a mean for an entire lake is not well known, but is on the order of 20 years for Lake Huron.

065531
ROGERS IH, MAHOOD HW * **Environmental monitoring of the Fraser River at Prince George. Chemical analysis of fish, sediment, municipal sewage and bleached kraft wastewater samples** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

066396
ROGERS IH, MAHOOD HW * **Thompson River survey. Chemical analysis of water, tissue and sediment samples collected August 1981 to March 1982** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

064411
ROGERS JS, HUANG PM, LIAW WK * **Chemical dynamics of mercury sorption and desorption of freshwater sediments** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

064888
ROSA F, NRIAGU FO, WONG HK, BURNS NM * **Particulate flux at the bottom of Lake Ontario** * Chemosphere * 12(9,10) 1345-1354 * 1983.

Time-series sediment traps deployed at closely spaced intervals near the bottom of Lake Ontario show that the amount of material collected decreases exponentially with increasing distance from the sediments. At heights of 0.2 and 7 m above the bottom about 85% and 45% respectively of the suspended tripton is recruited from the sediments. The upward flux of particles is strongly correlated with speed of bottom currents, and the turn-over rate for particles at the sediment-water interface is estimated to be only a few hours. It is believed that sediment resuspension is an important phenomenon which can readily account for several puzzling features connected with the distribution of pollutant metals in the Great Lakes sediments.

065152
ROTHWELL RL * **Erosion and sediment control at road-stream crossings** (see chapter 7.2 for complete reference - voir chapitre 7.2 pour la reference complete)

065258
RUDD JWM, TURNER MA * **The English-Wabigoon River system: 2. Suppression of mercury and selenium bioaccumulation by suspended and bottom sediments** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

066130
RUST BR * **Sedimentation in fluvial and lacustrine environments** , IN: Sediment/Freshwater Interaction, Proc 2nd Int Symp, Kingston, Ont, 15-18 June 1981 * Hydrobiologia * v91/92 59-70 * 1982-07-16.

Sedimentation in rivers is dominated by a complex set of physical processes, associated with the unidirectional flow of water. Variations in these processes give rise to different fluvial channel types, whose character can commonly be recognized in the ancient record. Chemical and biological processes are comparatively unimportant in fluvial sedimentation. In contrast, physical, chemical or biological processes can each dominate sedimentation in lakes. Physical (clastic) deposition dominates in high-latitude and mountain lakes (in which chemical and biological activity are low), and in lakes with high relief of the drainage basin and lake floor. Its variety reflects a range of processes influenced by river inflow, wave and current action, thermal and density effects. Economic benefits from the study of lake and river sedimentation include both resource and environmental aspects. An example is given of a mercury pollution study in a fluvial ecosystem. It shows that return to background levels can take place within a relatively short interval after cessation of pollutant input.

066502
SAMOILOFF MR, ARNOTT E, WEBSTER GRB, BELL J, BIRKHOLZ DA * **Evaluation of levels and kinds of toxic effects associated with chemical fractions of sediment from Tobin Lake, Saskatchewan** , IN: Proc 9th Annu Aquatic Toxicity Workshop, 1-5 Nov 1982, Edmonton, Alta * MACKAY WC * Can Tech Rep Fish Aquat Sci 1163 * 154-163 * Fish Oceans Can, Fish Habitat Manage Branch, Ottawa, Ont K1A 0E6 * 1983-11.

Two short-term biological tests, the Salmonella typhimurium (Ames) test for mutagenesis and the Panagrelius redivivus (nematode) developmental assay were used on chemical extracts of Tobin Lake, Saskatchewan, sediment samples. Two types of biological effect could be detected with S. typhimurium; (1) cytotoxic effects, limiting bacterial growth, and (2) mutagenesis. The Panagrelius redivivus developmental assay detects 4 types of effect (in decreasing order of priorized risk): (1) lethality, (2) sublethality, (3) inhibition, (4) mutagenesis. The chemical extraction protocol involves both differential solubility and elutability from Florasil.

Sites near the point where the Saskatchewan River enters the lake show maximal toxic effects in a neutral fraction eluting from florasil with 1:1 hexane-dichloromethane. Sites further downstream show toxicity associated with more polar fractions. Fifty-four potentially toxic compounds were identified in the toxic neutral fraction from the upstream sites although only 5 compounds were found in the toxic fraction from both upstream sites. These compounds are 2-nonenal, nexyl-e methyl cyclopentane, 1,9-nonanediol, tetradecanol and benzaldehyde.

066120
SAUNDERSON HC * **Bed form diagrams and the interpretation of eskers, chapter 7** , IN: Research in glacial, glacio-fluvial, and glacio-lacustrine systems, Proc 6th Guelph Symp on Geomorphology, 1980 * DAVIDSON-ARNOTT R, NICKLING W, FAHEY BD * Dep Geogr, Univ Guelph Geogr Publ No 6 * 139-150 * Geo Books, Regency House, 34 Duke St, Norwich NR3 3AP, GB * 1982

Bedform stability diagrams offer considerable potential as an aid in the interpretation of glaciofluvial structures preserved in eskers. Structures of open channel and sub-glacial, free-surface flows are easier to interpret because of the abundance of experimental data available. Competency diagrams and stability diagrams may be used to obtain estimates of palaeovelocity and palaeodepth, from which other hydraulic parameters may be extrapolated. Although structures of sub-glacial, full-pipe flows are less well documented, some assistance to interpretation is forthcoming from pipe flow stability diagrams. Of particular note is the absence of antidunes from full pipe flows: recent experiments indicate that antidunes are replaced by a plane bed in sands where a bed is already in existence. Experiments by others show the presence of a sliding bed mode of transport between a plane bed and total suspension of sediment.

062050
SCHAFER CT, SMITH JN * **River discharge, sedimentation, and benthic environmental variations in Miramichi Inner Bay, New Brunswick** (see chapter 4.1 for complete reference - voir chapitre 4.1 pour la reference complete)

066694
SCHWEYEN T, LAST W * **Sedimentology and paleohydrology of Waldsea Lake, Saskatchewan** , IN: Third Biennial Plains Aquatic Research Conf, Proc, August 24 and 25, 1983, Montana State Univ, Bozeman, MT * SCOTT MD * Can Plains Proc 11 * 45-59 * Inst Nat Resour, Dep Earth Sci, Montana State Univ and Can Plains Res Cent, Univ Regina * 1983.

Waldsea Lake is a small meromictic saline lake in central Saskatchewan. The chemocline was first measured at 4 m depth in 1971, and has since dropped to 9 m. Despite its change in elevation, it is still capable of supporting a bacterial plate composed primarily of Chlorobium spp. Major ion chemistry shows that the lake is of the Mg-Na-SO4-Cl type. The lake irregularly allows massive precipitation of carbonates in the form of aragonite and also occasionally gypsum. These events are rather shortlived, and are represented in the sediment as laminations of nearly pure aragonite of gypsum. Because the lake occupies a closed basin the lacustrine fill provides a detailed record of the late Holocene history of the lake. Sediment cores of the upper 4 m show a complex history of clastic, chemical, and organic sediment input. Superposed on this is an intricate assemblage of early diagenetic effects. The allogenic component consists of fine-grained quartz, dolomite, calcite, feldspars, and clays. Endogenic components include aragonite and gypsum. Early diagenetic dolomite, gypsum, and pyrite are also present. Organic content varies significantly but irregularly throughout the cores. Radiocarbon dating suggests that the upper 4 meters of sediment were deposited during the last 4000 years, and that sedimentation rates have varied significantly. Stratigraphically, these sediments indicate a small shallow, hypersaline lake with extensive mudflats existed in the basin about 4000 years B.P. With the exception of several small reversals, the lake has been continually deepening and becoming less saline throughout its history, likely due to the effects of a moderating climate.

066805
SCOTT DB, MUDIE PJ * **Sedimentation patterns in the Annapolis Head Basin: pre- and post-causeway as determined from micropaleontological evidence** * 19p * NS Tidal Power Corp, Halifax, NS * 1982-02.

The object of this study was to determine the amount of sedimentation that has taken place behind the Annapolis causeway, Annapolis Royal, Nova Scotia, since construction. Cores were obtained from the area directly behind the causeway and pre-causeway and post-causeway sediments were delineated. Three criteria were used to determine this boundary: general sedimentological characteristics; foraminifera content of the sediment; and, pollen-dinoflagellate content of the sediment. Following a brief description of oceanographic conditions in the area these results are presented and interpreted. At the first three sites sampled no sedimentation has taken place since the causeway was built. At the following 7 sites, however, varying amounts of sedimentation have occurred in post-causeway times with the most occurring in the deepest part of the basin. Sedimentation patterns appear to have shifted in response to the

construction of the causeway. These changes can be directly related to circulation pattern alterations brought about by the emplacement of the causeway.

062330
SCRUDATO RJ, DELPRETE A * **Lake Ontario sediment - mirex relationships** * J Great Lakes Res * 8(4) 695-699 * 1982.

Sediment samples collected from within the eastern basin of Lake Ontario, the Oswego River and harbor indicate that mirex, a persistent chlorinated hydrocarbon continues to accumulate in harbor and offshore lake sediments. A high statistical relationship exists between mirex and organic carbon concentrations in deep water lake sediments. Mirex-contaminated sediments are accumulating in the deeper waters (greater than 100m) of the lake at rates ranging from about 2.2-7.0 mm/yr. Nearshore bottom sediments are subject to redistribution, providing a continuing source of mirex to lake organisms.

F10292
SERODES JB, DUBE M * **Dynamique sedimentaire d'un estran a spartines (Kamouraska, Quebec)** * Nat can * 110(1) 11-26 * 1983.

La dynamique sedimentaire d'un estran a spartines situe a Kamouraska (Quebec) sur la rive sud de l'estuaire moyen du Saint-Laurent, a ete etudiee sur un cycle annuel a l'aide de plaques horizontales et de tiges verticales visitees periodiquement. La legere erosion de la slikke qui se produit entre mai et novembre, est compensee en hiver par une sedimentation sous le champ de glace, ce qui indique que les estrans sont sensiblement en equilibre. Ces resultats sont confirmes par les analyses geochimiques des sediments de la slikke et des carottages sur le schorre. Les vents du nord-est sont parmi les facteurs qui influencent le plus les processus sedimentologiques. Ils provoquent une forte remise en suspension des sediments, amplifient les courants de maree lors du remplissage et changent la direction de la vidange des estrans, elargissant ainsi considerablement la bande d'eau turbide qui baigne normalement ces derniers. Ces particularites tendent a eroder les parties lineaires du rivage en faveur du centre-ouest des baies en spirale faisant face a l'est et se developpant a l'abri de tetes rocheuses.

062909
SHERSTONE DA * **Sediment removal during an extreme summer storm: Muskwa River, northeastern British Columbia** * Can Geotech J * 20(2) 329-335 * 1983-05.

Extreme summer storms in northwestern Canada can produce large changes in river channels and sediment loads in a short time. These infrequent events cause effects downstream that persist over several years. Photogrammetric measurement was made of sediment removed during a 36-h storm flood in June, 1977, on the Muskwa River near its confluence with the Fort Nelson River. The approximate volume of material removed was 1 398 000 cu m. The sediment load added to the Fort Nelson River was between 2.3 and 2.4 million tonnes. Photogrammetric measurement techniques, combined with field samples, can provide adequate information on sediment removed during severe storms.

066132
SLAYMAKER O * **Land use effects on sediment yield and quality** . IN: Sediment/Freshwater Interaction, Proc 2nd Int Symp, Kingston, Ont, 15-18 June 1981 * Hydrobiologia * v91/92 93-109 * 1982-07-16.

Attempts to establish land use effects on sediment yield and water quality require consideration of (1) background biogeochemical cycling, (2) quantitative land use mapping, (3) selection of appropriate transport and attenuation models and (4) assessment of critical or threshold amounts, and types of land use change. Progress in each of these problem areas is considered.

063637
SLY PG * **Recent sediment stratigraphy and geotechnical characteristics of foreset and bottomset beds of the Niagara Bar** * J Great Lakes Res * 9(2) 224-233 * 1983.

Forest beds of the Niagara Bar are composed of fine sands and sandy silts. Their thickness is uncertain, but probably 6 to 8 m have accumulated on the upper slope since the last low water stage in Lake Ontario. The maximum thickness of these beds occurs near the foot of the outer slope (water depths 80 to 90 m) where accumulation exceed 20 m north of the present river mouth, and 10 to 12 m to the northwest. The bottomset beds of fine silt and silty clay thin rapidly offshore and decrease to as little as 0.5 m, at about 5 km northwest of the Outer Bar. There is a fining upward lithology in many cores, and this is consistent with continuing deposition under rising water levels. Geotechnical measurements indicate that bottomset and lower foreset beds have low undrained shear strenghts (typically less than 4 k Pa) and high water contents. Upper foreset beds, of coarser composition, have somewhat higher, undrained shear strengths (20 to 90 kPa, and greater) and much lower water contents. The steepest parts of the Outer Bar lie between 20 and 60 m water depth, where slope angles vary between 2 and 10 degrees; maximum local values reach 14 to 15 degrees. Despite the presence of gas in sediments of the lower foreset beds the slope shows no evidence of slumping.

063630
SLY PG * **Sedimentology and geochemistry of recent sediments off the mouth of the Niagara River, Lake Ontario** * J Great Lakes Res * 9(2) 134-159 * 1983.

Sediment thickness and bathymetric characteristics were derived from echo sounding, side scan sonar, and shallow seismic reflection recordings. Sediment samples were analyzed for particle size, major and trace elements, and for benthic organisms. The Niagara Bar has been separated into Inner and Outer Bar deposits and it is proposed that the Outer Bar was formed during an earlier, lower stage of Lake Ontario. Both deposits appear to be largely derived from reworked, local, shoreline materials. Trace elements analyses indicate that the surficial sediments (prior to the 1972 Great Lakes Water Quality Agreement) were moderately enriched in Cd, Cr, Cu, Pb, and Zn, and greatly enriched in Hg. Normalized distributions of trace elements in the bar sediments show the presence of distinct dispersal patterns. These dispersals indicate that some of the suspended load passes out of the main outflow channel, across the bar, and toward west and north northwest directions. Particle-size and geochemical characteristics of the off-shore sediments indicate that they differ significantly from marginal facies and imply that local variations in the forms and type of peripheral inputs to the lake have little influence on deep basin deposits.

062371
SLY PG, THOMAS RL, PELLETIER BR * **Comparison of sediment energy-texture relationships in marine and lacustrine environments** * Hydrobiologia * v91 71-84 * 1982.

Sediments in the marine environment are generally subject to higher energy levels than those of lake systems, and lakes are virtually unaffected by tidal range which modifies beach structures formed in response to wave effects. However, despite different energy levels, the textural characteristics of both marine and lacustrine sediments are very similar. The main difference between marine and lacustrine facies is the depth range over which these characteristics remain consistant. In lakes, depth limitation may influence the development of surface waves and restrict textural distributions. Simple textural relationships can be used to describe comparable marine and lacustrine sedimentary conditions. Sediments which have been altered by post-depositional erosion, such as lag deposits, or by ice-drop or wind blown settlement, show comparable textural modifications. The settlement of silt and clay size particulates, in the marine environmental and lakes, may differ slightly because of the chemical differences between salt and fresh water.

062790
SMITH JN, LORING DH * **Geochronology for mercury pollution in the sediments of the Saguenay Fjord, Quebec** * Environ Sci Technol * 15(8) 944-951 * 1981-08.

Sediment samples collected from the Saguenay Fiord between 1964 and 1974 revealed that the fiord sediments were contaminated with mercury apparently released from a chlor-alkali plant situated on the Saguenay River at Arvida. A series of cores collected in 1976 was analyzed for both mercury and radionuclides in order to determine sedimentation rates in the fiord and the geochronology of mercury contamination in the sediments. In this paper the detailed pattern of mercury deposition throughout the fiord is discussed, and mercury fluxes to the sediments are estimated for the period 1940-1976.

066115
SMITH ND, VENOL MA, KENNEDY SK * **Comparison of sedimentation regimes in four glacier-fed lakes of western Alberta, chapter 10** , IN: Research in glacial, glacio-fluvial, and glacio-lacustrine systems, Proc 6th Guelph Symp on Geomorphology, 1980 * DAVIDSON-ARNOTT R, NICKLING W, FAHEY BD * Dep Geogr, Univ Guelph Geogr Publ No 6 * 203-238 * Geo Books, Regency House, 34 Duke St, Norwich NR3 3AP, GB * 1982.

Physical characteristics and sedimentation regimes of 4 river-dominated lakes fed by glacial meltwater are described and compared. The 4 lakes (Lower Waterfowl, Peyto, Hector, and Bow) are all located in intermontane valleys in the eastern Canadian Rocky Mountains. Sedimentation patterns are strongly influenced by the type of initial mixing between inflow and lake water. Each of the 4 lakes is characterized by one of three kinds of inflow pattern: homopycnal, underflow, or overflow-interflow. Lower Waterfowl Lake is shallow and unstratified, and inflow carries uniformly low suspended sediment concentrations. Inflow mixing is homopycnal, and fine sediment is dispersed homogeneously through the lake, yielding negligible crosslake and only weak downlake trends in sedimentation (grain size, deposition rates). In Peyto Lake, high inflowing suspended sediment concentrations result in predominantly underflows, and sediment transport and deposition patterns are largely controlled by bottom topography. Hector and Bow Lakes are both deep and thermally stratified during summer. Inflowing river water, carrying only moderate suspended loads, is less dense than the deep (hypolimnial) lake water and therefore enters the lakes as overflows and shallow interflows which are deflected rightward by the Coriolis effect. Pronounced crosslake as well as downlake sedimentation trends characterize both lakes. Abundant fecal pellets of suspended-sediment-ingesting zooplankton, probably calanoid copepods, occur in Bow Lake. These may

comprise an important, though previously unappreciated, mechanism in the dynamics of clay transport and deposition in similar lakes dominated by fine-grained clastic sediments.

065183
SOPUCK VJ, LEHTO DAW, SCHREINER BT, SMITH JWJ * **Interpretation of reconnaissance lake sediment data in the Precambrian Shield area, Saskatchewan** * 53p * Sask Res Counc, Saskatoon, Sask * 1980-03.

Normalizing of metal contents in lake sediments is important due to variations in the physiochemical conditions and local bedrock chemistry from lake to lake. Normalization procedures for Cu, U, Zn, Ni and Co in lake sediments were established by detailed studies within the Maguire Lake area. In this report, the normalization procedures established in the Maguire Lake area are applied and tested for lake sediment metal data throughout the Saskatchewan portion of the Canadian Shield The report is divided into three sections: metal partitioning among lake sediments components; regional controls on Cu, Co, Ni and Zn in lake sediments in the GSC-SGS survey area; regional controls on metal in lake sediments throughout the Saskatchewan Shield.

F11631
ST-PIERRE S, MESSIER D * **Bilan sedimentaire des rivieres Eastmain et Opinaca et evaluation de l'influence des seuils sur le transport sedimentaire** * 26p * Sco energie de la Baie James, Montreal, Que * 1983-06.

Pour augmenter les volumes d'eau de la riviere La Grande, operation qui s'inscrivait dans la realisation du complexe hydroelectrique La Grande, les eaux des rivieres Petite Opinaca, Opinaca et Eastmain furent detournees respectivement en juillet 1979, avril 1980 et juillet 1980, modifiant ainsi l'equilibre dynamique de leur cours. Afin de recreer des conditions hydrologiques favorisant un habitat plus stable, trois seuils furent construits sur la riviere Eastmain. La presente etude vise a etablir un bilan sedimentologique des rivieres depuis la coupure de leur debit et a evaluer l'effet de la construction des seuils sur l'evolution de certains parametres physico-chimiques tel la charge des sediments en suspension et la turbidite.

066095
TAMBURI AJ, HAY D * **Hydrodynamics and sediment patterns on the Fraser foreshore** , IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * v2 537-557 * Can Soc Civ Eng * (1981).

Data collected on both Roberts and Sturgeon banks have been organized to assess the gross hydrodynamic patterns including the interaction of the Fraser distributories with Straits of Georgia flow on the banks. While potentiometric flow dominates the banks, clockwise gyres form both on Sturgeon and Roberts Bank late on flood tides. The Roberts Bank gyre is centered on Canoe Pass on the foreshore whereas the Sturgeon Bank gyre is centered somewhat offshore of the outer edge of the foreshore. While the gyres influence sediment transport locally, sediment patterns are primarily generated by the Fraser distributories and the winter wave climate. Analysis of foreshore morphology reveals that north of the Superport the foreshore is a fluvial surface dominated by the Fraser River. South of the Superport the coastal morphology is appreciably different, and the foreshore has been substantially modified by coastal processes.

065753
TAMBURI AJ, SHEWFELD B, POMALAZA J * **Width-depth studies of the Mississippi River** (see chapter 4.1 for complete reference - voir chapitre 4.1 pour la reference complete)

062488
TAYLOR BR, ROFF JC * **Transport and particle size distribution of suspended and benthic organic matter in three headwater streams** * Hydrobiologia * 93(3) 281-288 * 1982-08-13.

Suspended and benthic organic matter transported by three streams of different character in southern Ontario were assessed. Rates of sediment deposition varied according to the riparian vegetation at a stream reach, but suspended POM concentrations showed little change within a stream. Particle size distributions of sediments were all J-shaped, and showed only minor differences between sites. Particle size distributions of suspended POM were characterized by two peaks, one in the 30 to 110 micro m class, the other in the less than 10 micro m class. Decreases in POM between sites were related to loss of coarse particles, and an increase in the height of the less than 10 micro m peak. Overall it appeared that the nature of allochthonous inputs and physical features such as water velocity were most important in determining the character of suspended and benthic POM in these streams.

064138
TELFORD M * **A hydrodynamic interpretation of sand dollar morphology** * Bull Mar Sci * 31(3) 605-622 * Rosenstiel Sch of Mar and Atmos Sci, Univ Miami, FL * 1981-07.

Sand dollars are shallow-domed echinoids which act as lifting bodies in water currents. Coefficients of lift (CL) were determined experimentally in air for a lunulate species, Mellita quinquiesperforata (0.040) and for a nonlunulate species, Echinarachnius parma (0.077). The difference in CL, which was shown to be statistically significant (P =

0.001), can be attributed partly to differences in camber and partly to the presence of lunules. Observations of water flow at 10 cm per sec confirmed that flow was attached and of a lift-generating pattern. Flow around E. parma was hindered by a relatively large standing vortex at the anterior margin. For M. sexiesperforata, which is thinner edged and less steeply cambered, the flow was more perfectly attached; flow from oral to aboral surfaces via the lunules was distinct. Similarly, Encope emarginata had a closely attached flow with some passage through the anal lunule and ambital notches. Calculations from weight-length relationships and coefficients of lift indicated that M. quinquiesperforata should be able to maintain its position in more severe current regimes than could E. parma. Excess pressure on the oral surface of lunulate sand dollars is relieved by flow along pressure drainage channels which lead from the central region of the disc into the lunules and ambital notches. Scanning electron micrographs show that these lack the podia characteristic of food grooves and that podia in adjacent food-gathering areas sweep parallel to or away from the pressure drainage channels. Several earlier theories of lunule function appear to be either insufficiently general or untenable. That lunules shorten the food-path is not fully supported by observation; that they aid in righting movements is contrary to observations of Mellita species and that they might strengthen the test is shown by both observation and theoretical considerations to be incorrect.

063628
THOMAS RL * **Lake Ontario sediments as indicators of the Niagara River as a primary source of contaminants** * J Great Lakes Res * 9(2) 118-124 * 1983.

Past studies on the distribution of mercury, PCB, and mirex in the surficial bottom sediments of Lake Ontario have clearly indicated the significance of the Niagara River as a major source of contaminants to the lake. The distributions have further indicated the net transport of sediment-bound materials in the lake which has assisted in the general understanding of the occurrence of contaminants at many trophic levels in the lake Ontario ecosystem. Mean concentrations of a number of elements in suspended solids centrifuged from the Niagara River in 1974 further indicated that the river is also a major source for chromium, cadmium, vanadium, and arsenic, and a lesser though significant source of lead, copper, and nickel.

062395
THOMAS RL * **Sediments of the North American Great Lakes** . IN: Verhandlungen-Proc-Travaux Int Association for Theoretical and Applied Limnology, Congress, Japan, 1980 * Verh Int Verin Limnol * 1667-1680 * E Schweizerbart'sche Verlagsbuchhandlung, D-7000 Stuggart I * 1981-12.

Geological research in the Great Lakes up to 1974 has been reviewed by SLY & THOMAS (1974). This short paper is intended to upgrade an earlier review by presenting more recent information that has become available. Knowledge and information pertaining to the Great Lakes sediment system has increased dramatically over the last decade due, in large measure, to studies undertaken for and reported to the International Joint Commission. Of particular significance are the Upper Lakes Reference Study (1976) and the report of the Pollution from Land Use Reference Group (1978). The former resulted in detailed description of the sediments of Lakes Superior, Huron and Georgian Bay, while the latter provided information on the sediments in shore-line materials and the suspended sediment of the tributaries draining into the Great Lakes. A number of studies have also been undertaken on sediment ion rates and elemental distribution in Lakes Michigan, Huron and Lake Erie. Due to contraints, this paper does not attempt to provide a detailed review, but restricts itself to updating the sediment textural information in the Great Lakes and to a description of some of the highlights of sediment geochemical investigations over the past five years.

063177
TUNNICLIFFE V, SYVITSKI JPM * **Corals move boulders: an unusual mechanism of sediment transport** * Limnol Oceanogr * 28(3) 564-568 * 1983-05.

Tidal currents over the sill of Knight Inlet, a fjord on the western Canadian coast, are frequently in excess of 1 m. per sq s. This shallow sill (65 m) is composed of cobble- to boulder-sized sediments that support extensive growths of large gorgonian corals. Although current-generated shear stresses are normally far from sufficient to initiate boulder movement, drag forces due to the attached corals do cause a significant rearrangement of the boulders on the sill.

062917
TURNER JV, FRITZ P * **Enriched 13C composition of interstitial waters in sediments of a freshwater lake** * Can J Earth Sci * 20(4) 616-621 * 1983-04.

The DIC (dissolved inorganic carbon) of interstitial waters from sediments of a small carbonate-precipitating lake in southern Ontario has highly enriched delta 13C values of up to 13 per mil relative to PDB (Peedee belemnite). This post-depositional isotopic enrichment is attributed to the metabolism of methanogenic bacteria. The delta 13C values of marl in the sediment profile are also enriched by an average of +3 to +4 per mil

relative to the associated molluscs. Photosynthetically induced carbonate precipitation and post-depositional recrystallization are among the processes that are considered to contribute to the isotopically enriched marls. Evidence for the latter process is drawn from geochemical analyses on interstitial waters, which show them to be at or very close to saturation with respect to calcite, indicating that net calcite dissolution has occurred, probably under the influence of high pCO2's generated by methanogenic bacteria. Such freshwater carbonate sediments with interstitial waters enriched in 13C provide a unique environment for study of isptope relations during carbonate diagenesis under accessible conditions and with a time scale of geologic relevance.

065600
WALKER RR * **Modelling sediment oxygen demand in lakes** * 244p * McMaster Univ, Sch Grad Stud, Hamilton, Ont * 1980-04.

Field and laboratory investigations were carried out to explore sediment oxygen demand (SOD) and its component parts. An in situ measurement device was built, tested and applied in Hamilton Harbour. Techniques were developed to measure SOD and oxygen uptake by chemical oxidation (CSOD). Sediment samples were taken from Hamilton Harbour and seven other lakes in Northern Ontario and Cape Breton Island. All samples were analyzed for organic content and selected samples were placed in laboratory columns. Experiments were conducted in which oxygen uptake was measured within the columns under controlled conditions. Sediment oxygen demand was fractioned into portions attributable to chemical oxidation, biological respiration and direct macroinvertebrate respiration. Models were selected to describe the dependence of each portion of SOD on oxygen concentration and temperature. Where possible, mechanistic explanations are presented for the models selected. Results indicate that the chemical portion of SOD is dependent on oxygen concentration in the manner of a first-order reaction and that it responds to temperature change in a manner typical of a mixed bacterial community. At high oxygen concentrations, anaerobic metabolic activity is found to be the limiting factor in CSOD. Bacterial and macroinvertebrate oxygen uptake are dependent on oxygen concentration at low concentrations, following a Monod kinetic form. These fractions respond to temperature in the same fashion as the chemical portion. Macroinvertebrates contribute a large part of the direct respiration as well as having a profound effect on the total community respiration.

064564
WALLIS PM * **The uptake of dissolved organic matter in groundwater by stream sediments - a case study** (see chapter 5.2 for complete reference - voir chapitre 5.2 pour la reference complete)

066093
WALTERS WH, WINKLEY BR * **A design method for mounded stone training structures in divided flow alluvial channels** . IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * v2 485-500 * Can Soc Civ Eng * (1981).

A design method is proposed for stone training dikes that are constructed to close off one channel where divided flow conditions exist to force development of deeper navigation depths in the opposite channel. The hydraulic relationships used in the proposed method are developed from the equations for the design of river closure dams using stone which is dumped into flowing water. The initial two design and construction phases are recognized as the most important when only partial closure of a river channel is necessary. Design equations for both phases are developed which specify the cross-sectional dimensions and stone size based on the selected design depth and velocity in the channel where flow is to be reduced. The proposed methodology predicts the cross section required for a stable configuration, the size of stone required, and provides an estimate of the volume of stone based on hydraulic conditions at the site.

066117
WEIRICH FH * **Site location and instrumentation aspects of a study of sedimentation processes in a proglacial lake in southeastern British Columbia, Canada, chapter 11** , IN: Research in glacial, glacio-fluvial, and glacio-lacustrine systems, Proc 6th Guelph Symp on Geomorphology, 1980 * DAVIDSON-ARNOTT R, NICKLING W, FAHEY BD * Dep Geogr, Univ Guelph Geogr Publ No 6 * 239-260 * Geo Books, Regency House, 34 Duke St, Norwich NR3 3AP, GB * 1982.

The paper examines research conducted on a small, unnamed proglacial lake in southeast British Columbia, Canada. The study concentrates on continuous monitoring of sediment concentration, currents and temperature in the lake and correlates changes in these parameters with the nature of the sediments being deposited. Specifically, the work is a process study of lake bottom sediments deposited by density currents. A secondary goal is to analyse the entire mesoscale glacial-hydrologic system of which the lake is only a component. The present discussion outlines the characteristics of the site, the general nature of the study, and in particular, describes the instrumentation involved.

066094
WIGHAM JM, BECK SM * **A model study of local scour around pile bent bridge piers** , IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * v2 501-513 * Can Soc Civ Eng * (1981).

Pile bents or groups of piles acting as a unit can be used as bridge piers in situations where significant lateral pressures are not likely to develop. They are also used as supports for more conventional pier shapes where foundation conditions warrant such treatment. A model study was initiated to investigate the scour process around pile bents and to determine the location and maximum depth of scour for various flow conditions, angle of attack, and pile spacing. A simple pile bent system of four cylindrical piles in a straight line was used in the main test program. Some preliminary model tests were conducted, using standard bridge pier shapes, to provide a basis of comparison and to determine the best operating conditions for the model tests. The results of sixty model tests are presented and the effects of angle of approach and pile spacing are discussed. Comparisons are made with the published results of other model studies and conclusions, relative to the pile bent configuration tested, are presented.

064161
YUZYK TR * **Lake Diefenbaker, Saskatchewan: a case study of reservoir sedimentation** * vp * Environ Can, Inland Waters Dir, Water Resour Branch, Water Surv Can Div, Sediment Surv Sect, Ottawa, Ont * 1983.

In 1965 a field survey program was implemented to monitor general sedimentation patterns, delta formation and bank erosion in what was to become Lake Diefenbaker. After fifteen years of data collection it was agreed that this program should be reviewed. The review focussed on two principal areas: to compile, analyse and interpret all the data collected from Lake Diefenbaker and document the sedimentation patterns; to evaluate the existing data collection program and identify changes required to ensure an effective and efficient program. Sedimentation has not significantly affected the reservoir operation, since only 1.4% of the total reservoir capacity has been lost between 1966-1980. Delta formation was determined to be affected by a low original bed slope, large water level drawdown and reduced sediment loadings in the latter years. The bed slopes indicate that the delta structure has yet to reach equilibrium. Bed material sampling showed that deposited densities were considerably lower than empirically derived values, which greatly affected the deposited load estimates. Recommendations were made based on the findings of this report.

7.2 Erosion - Erosion

066012
Atlantic coastal erosion and sedimentation workshop; papers presented at the Atlantic coastal erosion and sedimentation workshop, held November 25, 1982 in Halifax, N.S. (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

062250
BECKSTEAD GRE * **Woolford Park Groynes as constructed report** * 20p * Alberta Dep Environ, Environ Eng Support Serv, Tech Serv Div * 1981-03.

This report examines the erosion problem on the St. Mary River at Woolford Provincial Park. A Summary of past attempts at controlling river shifting and erosion prior to construction of the present system of groynes is given. Details are provided on the construction of the four riprapped groynes built during the winter of 1975-1976. The cost of construction totaled almost $50,000,000 and involved the building of the four groynes and sloping the eroded right banks with local river gravel, and the hauling, stockpiling and placement of rock riprap. Design calculations are included, and complete as-constructed surveys are presented which may be used in assessing the performance of the groyne system, and obtaining useful design information for similar structures.

062774
BOCZAR-KARAKIEWICZ B, BONA JL * **Shallow-water waves over a gently sloping beach** (see chapter 4.10 for complete reference - voir chapitre 4.10 pour la reference complete)

063803
BOYD GL * **Canada/Ontario Great Lakes erosion monitoring programme, final report 1973/1980** * Manuscr Rep Ser 12 * 200p * Fish Oceans Can, Bayfield Lab Mar Sci Surv, Ocean Sci Surv, PO Box 5050, Burlington, Ont L7R 4A6 * 1981-12.

This report documents the results of a joint study undertaken by the Government of Canada and the Province of Ontario to monitor and assess erosion on the Great Lakes Canadian shoreline. At 162 sites, intended to represent the entire erodible shore from Port Severn on Georgian Bay to Kingston on Lake Ontario, onshore and offshore measurements were taken annually for the period 1973 to 1980. The investigation was initiated due to extensive shore damage previously documented (Canada/Ontario Great Lakes Shore Damage Survey, 1975), which indicated that a broader understanding of shore processes was necessary to mitigate future damage and to assist shore management and planning. The results should be of interest to specialists working in the coastal zone and to avid laymen concerned

about shore erosion of their property or in their jurisdiction.

065629
CAPG CAN ATLANTIC POWER GROUP LTD * **Annapolis tidal power project headpond erosion study** * 80p * CAPG Can Atlantic Power Group Ltd, Suite 212, Duke St Tower, Halifax, NS B3J 1N9 * 1982.

The objectives of the study reported in this volume was to obtain estimates of the increases in erosion rates likely to result from the operation of the Annapolis Tidal Power Project and recommendations for shoreline protection if and where appropriate. The study area included the Annapolis River headpond from Annapolis Royal to Bridgetown. The study was divided into four phases: A) Shoreline Variability Analysis; B) Shoreline Profiling; C) Erosion Prediction and; D) Remedial Works. For Phase A a detailed inventory of the main characteristics of the shoreline was prepared and their present condition and future susceptibility to erosion was assessed. This information is presented in both tabular and map form. Shoreline profiling for Phase B was done at a number of sites determined from the Phase A portion of the study. The results are presented in tabular form in Appendices A to F. Erosion prediction (Phase C) was limited to a qualitative assessment of the forces involved in the erosion process (waves, currents, frost action, ice action) and to assess whether this process will be accelerated or retarded as a result of the rise of water level due to new operating conditions in the headpond. It is shown that the rate of erosion will not be appreciably affected by the rise in the mean water level as a result of higher operational levels at +1.83 meters and +2.29 meters therefore bank protective measures are not considered necessary at the present. Phase D recommends a program of shoreline monitoring at 5 year intervals be adopted in those patches of shoreline where erosion may be acute. If any patch of shoreline would show signs of excessive erosion, isolated bank protection works may be undertaken depending upon the value of the property in question. The recommended method of protection is to flatten the slope of the bank and to use armour rock to arrest further erosion.

F11912
CHAPUIS RP, GATIEN A * **Mesure quantitative de l'erodabilite des argiles soumises a un ecoulement, par une technique de cylindre rotatif** . IN: 6e Conf can d'hydrotechnique, comptes rendus, 2-3 juin 1983, Ottawa, Ont * TOWNSEND RD * vi 379-398 * Soc can genie civ * 1983-06.

Pour predire l'erodabilite des sols argileux soumis a un ecoulement, il existe diverses methodes qui fournissent, pour une meme argile, des predictions extremement differentes, parce qu'elles ne tiennent pas compte des parametres physico-chimiques, qui vraisemblablement gouvernent les processus d'erosion des argiles. L'article presente alors une technique experimentale de cylindre rotatif, recemment perfectionnee par les auteurs. Cette technique permet de controler les parametres essentiels du phenomene: on etablit la capacite d'erosion d'une eau connue, de qualite controlee; on mesure precisement la masse seche des particules erodees par unite de surface et de temps dans des conditions connues; on determine avec precision la containte de cisaillement generee par l'ecoulement sur la paroi argileuse. Apres la description de l'appareillage et de la methodologie d'essai, l'article fournit quelques resultats interessants tires d'experiences effectuees au cours des trois dernieres annees.

062768
DAVIDSON-ARNOTT RGD, AMIN SMN * **Application of computer modelling and sediment budget techniques to shore erosion problems, S.W. Lake Ontario** (see chapter 7.1 for complete reference - voir chapitre 7.1 pour la reference complete)

063784
DE JONG E, BEGG CBM, KACHANOSKI RG * **Estimates of soil erosion and deposition for some Saskatchewan soils** * Can J Soil Sci * 63(3) 607-617 * 1983-08.

137Cs from the atmospheric testing of nuclear devices in the 1950s and 1960s was used to estimate soil erosion in eight small basins in hummocky topography. Three basins had not been cultivated since the 1950s and in these 137Cs showed little or no separation according to landscape position. In the cultivated basins, 137Cs increased from the top to the bottom of the slopes reflecting the simultaneous occurrence of soil erosion on the upper slopes and deposition on the lower slopes. The redistribution of 137Cs was least in a cultivated basin where water erosion was minimal. From the 137Cs it was estimated that over the past 20-25 yr the upper slopes in the cultivated basins had lost 20-60 kg soil/sq m, whereas the lower slopes had gained 25-80 kg/sq m. Some middle-slope positions lost soil, others gained. An attempt to construct 137Cs and soil balances for each of the cultivated basins was only partially successful. The inability to accurately delineate areas of erosion and areas of deposition is probably the major obstacle in calculating accurate balances for the basins. The 137Cs balances did show promise of being able to separate soil losses by wind and water erosion.

061766
DE JONG E, VILLAR H, BETTANY JR * **Preliminary investigations on the use of 137Cs to estimate erosion in Saskatchewan** * Can J Soil Sci * 62(4) 673-683 * 1982-11.

Records of radioactive fallout on the Canadian Prairies indicate that 137 Cs should be present in soils at levels that can be counted relatively accurately. Less than 7% of total 137Cs appears to have fallen during the winter months, so that redistribution of 137Cs with blowing snow should not seriously impair the possibility of using 137Cs as a tracer for soil erosion. Methodology for measuring 137Cs in soil samples is described, as is a semi-empirical method for correcting for the effect of bulk density of the sample on counting efficiency. Preliminary data indicate that noneroded soils in the Saskatoon area contain about 6.4 pC 137Cs/sq cm. There was little variation in 137Cs with slope position on gently rolling sites under native vegetation, whereas there was considerable redistribution in cultivated fields. It was estimated that a knoll in one cultivated field had lost about 10% of its topsoil since the early 1960s when most 137Cs was deposited.

065178
DICKINSON WT * **Occurrence and control of soil erosion and fluvial sedimentation in selected basins of the Thames River watershed** * Stratford/Avon River Environ Manage Proj, Tech Rep R-5 * 33p * 1982-08.

This report summarizes results from the application of the soil-loss/sediment-deliver model GAMES to selected small watersheds in the Avon River and lower Thames River basins. GAMES was developed to describe and predict soil loss by water erosion and the subsequent delivery of suspended solids from field to stream and downstream in agricultural areas. The modelling analysis indicates that it is well to consider the rolling upland watersheds such as the Avon basin somewhat differently than the level watersheds of the lower Thames basin when assessing soil erosion and stream sediment problems. In the upland watersheds, average soil loss rates may not be considered excessive though there is evidence of localized erosion problems. Sediment sources are even more localized than the erosion-prone sites. Erosion and sediment delivery can therefore be effectively achieved by the application of remedial measures to site-specific problem areas. The level lowland watersheds, on the other hand, present neither general nor local soil erosion problems, the estimated soil-loss rates being ralatively low. If either the low erosion rates or the sediment delivery rates are to be controlled for reasons of agricultural productivity or water quality, then widespread control measures would be required. These would involve extensive changes in soil and crop managment systems.

065851
FORTIN M * **Cropping-income impacts of management measures to control soil loss** * Stratford/Avon River Environ Manage Proj Tech Rep R-18 * 18p * 1982-11.

Certain crop management measures involving tillage practices and the choice of cropping systems can reduce erosion and help control resulting water quality problems. They may also impact net farm incomes by increasing production costs or reducing yields and sales revenues. These economic impacts are estimated in this report for the Avon River Basin using production cost data, crop price date and crop yield figures for Ontario. Published information on erosion control measures is combined with information acquired from agricultural workers in the Stratford area to develop estimates of likely impacts. While the impact figures are only approximate, they do provide background information to help evaluate and develop an agricultural program for water quality control. Notable findings are that: a) the use of short cash crop rotations to replace a corn monoculture system may be justifiable on economic grounds alone; b) conservation tillage based on the fall use of a chisel plow on silt loam soils may be economically prohibitive; c) cross-slope or contour tillage can be usefully applied to only a limited portion of productive land in the Avon River Basin. The analysis presented here is partial in that benefits related to reduced soil loss and to lower sedimentation of drains are not assessed.

063493
GARDNER JS * **Observations on erosion by wet snow avalanches, Mount Rae area, Alberta, Canada** * Arct Alp Res * 15(2) 271-274 * 1983-05.

Observations of two wet snow avalanches indicate that their erosive effects are highly specific and cannot be readily generalized. One full-depth, wet snow avalanche moving over snow-free and thawed debris surfaces had no erosional impact. This effect was the result of a protective veneer of wet snow deposited by the avalanche as it moved over the ground. The other example which occurred in apparently similar snow and terrain conditions produced measurable erosive effects. These observations suggest that care must be taken when inferring or assuming avalanche erosion processes in interpretation of landforms and deposits.

065177
GRAHAM A, KNIGHT G * **Gully erosion control demonstration project** * Stratford/Avon River Environ Manage Proj, Tech Rep R-16 * 11p * 1982-09.

Two demonstrations of gully erosion control were carried out on a co-operator's property in the demonstration sub-watershed of the Avon River during 1981. The construction of a rock

chute and the installation of a drop-inlet structure with tile outlet protection served to demonstrate two both simple and economical means of controlling a common erosion problem. Such methods of stabilizing the gullies proved quite acceptable to the landowner while providing a future reduction of sediment contributions to the private drain receiving the discharge.

065174
GRAHAM A, KNIGHT G * **Grassed waterway demonstration projects** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

065179
GRAHAM A, KNIGHT G * **Demonstration of earth berms and drop inlet structures** * Stratford/Avon River Environ Manage Proj, Tech Rep R-2 * 14p * 1982-09.

A series of three berms with drop inlet structures leading to a subsurface tile were constructed or improved in the lower end of the Avon River drainage basin during 1981. The purpose of these projects was to demonstrate cost-effective means of controlling soil erosion with minimum interference to the agricultural practices in the area. The structures control rill and gully erosion while causing a portion of the sediment load in the surface runoff to settle out in temporary pounds behind the berms. Landowner acceptance and local reactions have been favourable to the projects. Further surveillance of these structures will reveal the degree to which they have succeeded in controlling soil erosion.

065176
GRAHAM A, KNIGHT G * **Stripcropping demonstration project** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

062769
HALES LZ * **Feeder beach solution to shoreline erosion** , IN: Proc Canadian Coastal Conf 1983, Vancouver, 11-14 May 1983 * HOLDEN BJ * 285-299 * Natl Res Counc, Assoc Comm Res Shoreline Erosion Sediment, Ottawa, Ont K1A OR6 * 1983.

The Surfside-Sunset Beach region of southern California lies at the upper portion of a littoral cell, and thus receives no input of longshore transport from upcoast. The incident wave climate is such that a large net downcoast movement of littoral material exists (276,079 cu yd per year), which must be periodically replaced to prevent downcoast erosion. Proposals to construct a new entrance channel to Bolsa Chica Bay (with the accompanying stabilization jetties) will completely interrupt the littoral regime. A sand-bypassing concept has been developed to operate in concert with a weir jetty system to mitigate effects of the jetties on the unstabilized downcoast shoreline.

063766
JESSEN S, DAY JC * **Regulating Great Lakes flood and erosion hazards: the Haldimand - Norfolk experience, Lake Erie, Ontario, Chapter 3** (see chapter 4.2 for complete reference - voir chapitre 4.2 pour la reference complete)

063624
KAMPHUIS JW * **On the erosion of consolidated clay material by a fluid containing sand** * Can J Civ Eng * 10(2) 223-231 * 1983-06.

Erosion of a consolidated clay material by fluid containing sand was tested in a laboratory facility. Two modes of erosion were distinguished: "sand blasting" or impact of individual sand particles moving by saltation and "milling" by sand particles forming part of a moving bed layer of discontinuous dunes. Sand blasting resulted in the more severe erosion and this process was adjusted during the experiments to yield maximum erosion rates. It was found that the overall bed degradation rate was a result of many local, shallow erosional features which coalesced. The maximum overall rate of bed degradation was found to be of the order of 0.2 mm/h or 1.75 m/year for a clay material consolidated to 345 kPa.

061884
KREUTZWISER R * **An evaluation of government response to the Lake Erie shoreline flood and erosion hazard** (see chapter 4.2 for complete reference - voir chapitre 4.2 pour la reference complete)

F11635
LES CONSULTANTS SOGEAM INC * **Detournement Eastmain-Opinaca-La Grande, etude de l'erosion sur le parcours des eaux derivees Boyd-Sakami (1982)** * 22p * Les consultants SOGEAM inc, Longueuil, Que * 1983-04.

Ce travail s'inscrit dans le cadre d'un programme d'etudes visant a assurer le suivi de l'evolution des milieux affectes par l'amenagement du Complexe La Grande. Il traite pour une troisieme annee consecutive, de l'evolution morphologique du lit et des rives du parcours des eaux derivees et de la partie aval des evacuateurs de crues sur les rivieres Eastmain et Opinaca. Apres un bref rappel methodologique il presente un apercu de l'activite morphologique sur les chemins de detournement depuis la premiere ouverture de La Sarcelle en juillet 1980. Puis il aborde de facon detaillee la description des principales zones sensibles.

F11634
LES CONSULTANTS SOGEAM INC * **Detournement Eastmain-Opinaca-La Grande, etude de l'erosion morphologique du lit et des berges de la partie des rivieres Eastmain et Opinaca situee a l'aval des ouvrages de detournement (1982)** * 86p * Les consultants SOGEAM inc, Longueuil, Que * 1983-04.

Ce travail s'inscrit dans le cadre d'un programme d'etudes qui vise a assurer l'evolution des milieux affectes par l'amenagement du Complexe La Grande sur le territoire de la Baie James. Le rapport aborde l'etude morphosedimentologique de la partie assechee des rivieres Eastmain et Opinaca. Apres un bref rappel methodologique le rapport presente pour les troncons exondes des rivieres Eastmain, Opinaca et Petite Opinaca, le bilan de l'evolution morphologique des rives survenue en 1982. Ce bilan est analyse, interprete et compare avec celui de l'annee precedente.

065748
LINDNER DH * **Application and design practise of gabion drop structures in Alberta** , IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * 55-76 * Can Soc Civ Eng * (1983).

The use of gabions to contruct hydraulic structures is a functional, practical and economic solution to certain grade and erosion control problems. Since 1974, Alberta Environment has constructed 87 gabion drop structures on 13 distinct water management projects. Gabion construction is particularly suited to difficult foundation conditions, intermittent water courses, locations with sources of gabion rock and gravel, and construction under winter conditions. The application of gabion drop structures in Alberta and current design practise are outlined. Most of the structures have been designed for flow return periods ranging from 5 to 20 years, flows to 12 cum/s and drop heights of 2.5 m. The widest structure is 17 m wide, handles a design flow of 36 cum/s with a drop height of 1.5 m. The greatest drop height is 12 m for a 2 m wide structure and a design flow of 3.5 cum/s. The current design practise has evolved since 1974 and is largely based on practical design, construction and cost considerations, prototype observations and hydraulic model tests.

062754
LLOYD RJ * **Coping with the Great Lakes, Flooding and erosion, Part 1: The hazards, Part 2: Avoiding the hazards (audio-visual program)** (see chapter 4.2 for complete reference - voir chapitre 4.2 pour la reference complete)

065782
LORANT FI * **Erosion control by storm water management - is it worth a dam?** , IN: Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conf, Proceedings, June 2 & 3, 1983, Ottawa, Ont * TOWNSEND RD * v2 723-737 * Can Soc Civ Eng * (1983).

The policy on erosion control of streams advocated by Ontario Conservation Authorities and Municipalities, requires the developer to reduce the 2 or 5-year post-development peak flows to their respective predevelopment level by means of storage facilities. Although this seemed a good first step in reducing the potential erosion damages downstream, a recent study to determine the effect of flow control by storage on stream erosion has shown this to be to the contrary for certain conditions. This study developed a procedure to calculate the magnitude and distribution of erosive forces produced by different runoff hydrographs, representing pre and post-development conditions with and without control. Thus, the erosion potential, or the change in erosion potential, for different hydrographs were determined. Results identified the significance of flow duration on the erosion potential introduced. Whereas the reduction in peak flows achieved by storage may reduce the downstream flood levels which will result in a reduction in erosion at or near the top of the bank, the resulting increased duration of flow can aggravate the erosion near the bottom of the stream. It was therefore concluded that depending on local conditions, the use of storm water management ponds for stream erosion control could be ineffective, resulting in unnecessary high constuction costs coupled with continued and costly future erosion protection programs. Further application of the method outlined is planned to study actual stream erosion problems in or downstream of urban areas.

063300
MACLAREN PLANSEARCH * **Construction-related erosion and downstream aquatic environments, Rogers Pass Project** * 106p * 1983-03.

This report is concerned with aquatic habitats below the new CP Rail right-of-way (ROW) in that portion of the Beaver River drainage south of the northern boundary of Glacier National Park. It contains the results of an investigation of the risk to aquatic environments in the Beaver River valley from construction-related erosion. A plan for monitoring these environments during construction to reduce the risk of impact is also described. Literature on the impacts of sediment and sedimentation on beavers, fish and stream invertebrates is reviewed briefly. Data from previous studies of the area and from a special field study of the Beaver River and its tributaries which cross the new CP Rail right-of-way are used to identify areas of concern. The susceptibilities of stream, pond and marsh habitats to sediment and

sedimentation are evaluated by considering stream hydrology, the erosion potential of soils and slopes adjacent to the streams and the location of habitats relative to streams crossing the ROW. Most pond and marsh habitats are situated relative to streams crossing the ROW such that they would not be likely to receive significant quantities of sediment in the event of severe erosion of the ROW. Ponds and marshes on two unnamed creeks were judged to be highly susceptible and ponds on four creeks were judged to be moderately susceptible to sedimentation. Any impacts would probably be restricted to ponds furthest upstream on those creeks and are not likely to be irreversible. Fish populations in the Beaver River are not likely to be affected by sediment for this reason.

064086
MAGALHAES L, CHAU TS * **Initiation of motion conditions for shale sediments** * Can J Civ Eng * 10(3) 549-554 * 1983-09.

Critical shear stresses for erosion of alluvial shale particles were investigated in a laboratory flume. Tests in the incipient motion conditions of individual particles showed that entrainment of shale bed particles takes place at mean shear stress values 40-50% smaller than other types of non-cohesive and coarse granular material. The low density and platy shape of the shale particles may induce high lift forces, which would account for a decrease in the resistance to erosion of shale channels and greater rates of bed-load transport.

062771
MORGAN GC * **Beaching of shorelines of man-made lakes** . IN: Proc Canadian Coastal Conf 1983, Vancouver, 11-14 May 1983 * HOLDEN BJ * 169-183 * Natl Res Counc, Assoc Comm Res Shoreline Erosion Sediment, Ottawa, Ont K1A OR6 * 1983.

In an area of fine sediment and high exposure to wave action, shoreline regression of 600 m over a 5 year period has been observed in reservoirs in British Columbia. More commonly however the amount and rate of regression is much less severe. Nevertheless shoreline regression of a few metres can become a threat to shoreline structures in populated areas. This paper provides a basis for predicting the effect of beaching on the shoreline of man-made lakes. Some original work carried out on natural lakes to establish the relationship between long term beach slopes, grain size, and exposure is described. This work was followed by a field program of measurements of partially evolved beaches around several man-made lakes.

066045
NEWBURY RW, MCCULLOUGH GK * **Shoreline erosion and restabilization in a permafrost-affected impoundment** , IN: Permafrost: Fourth International Conference, Proceedings * 918-923 * National Academy Press, Washington, DC US * 1983.

In 1976, an 850 cu m/s river diversion was constructed through 300 km of permafrost-affected landscape in northern Manitoba. The diversion was accomplished by raising the level of a 1,977 sq km riverine lake on the Churchill River (Southern Indian Lake) until the water spilled across a terrestrial drainage divide into a series of small valleys tributary to the Nelson River. Over 400 sq km of permafrost-affected backshore area surrounding the lake were flooded. The mean annual temperature in the Southern Indian Lake region is -5C. Three repeated phases of shoreline erosion in permafrost materials were observed; melting and undercutting of the backshore zone, massive faulting of the overhanging shoreline, and removal of the melting and slumping debris. At erosion monitoring sites in fine-grained frozen silts and clays, representative of over three-quarters of the postimpoundment shoreline, rates of retreat of up to 12 m/yr were measured. The index of erosion based on the wave energy impinging on the shoreline was 0.00035 cu m/tonne. After 5 years of erosion, restabilization of the shoreline has occurred only where bedrock has been encountered on the retreating backshore. Clearing of the forested backshore prior to flooding did not affect the erosion rates. The rapidly eroding shorelines have increased the suspended sediment concentration in Southern Indian Lake water and have triggered degradation of the commercial fishery.

066092
RAJARATNAM N, DIEBEL M * **Erosion below culvert-like structures** . IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * v2 469-484 * Can Soc Civ Eng * (1981).

This paper presents the results of an experimental study on erosion below circular outlets with the tailwater depth approximately equal to the diameter of the outlet. The effect on the erosion of the width of the downstream channel has also been studied. It was found that the maximum depth of scour in the asymptotic state in terms of the diameter of the outlet was mainly a function of the densimetric Froude number and this functional relationship is essentially the same as that found earlier for large tailwater depth and large channel width. Correlations have also been developed for the other characteristic lengths. Further, the eroded bed profiles were found to be similar if analysed in two parts.

066121
RICE RJ * **The hydraulic geometry of the lower portion of the Sumwapta River valley train,**

Jasper National Park, Alberta, chapter 8 . IN: Research in glacial, glacio-fluvial, and glacio-lacustrine systems, Proc 6th Guelph Symp on Geomorphology, 1980 * DAVIDSON-ARNOTT R, NICKLING W, FAHEY BD * Dep Geogr, Univ Guelph Geogr Publ No 6 * 151-173 * Geo Books, Regency House, 34 Duke St, Norwich NR3 3AP, GB * 1982.

Morphologic and hydraulic data were gathered from 60 gravel channels (20/reach) on the Beauty Creek Flats section of the proglacial Sunwapta River during August 4-15, 1977. Four power functions (log-linear: width, average depth, average surface velocity and water surface slope) are determined for each reach and for Beauty Creek Flats as a whole with discharge as the independent parameter in all cases. A downstream hydraulic geometry interpretation indicates that the downstream reduction in the median grain size is mainly responsible for the variation in channel behaviour. In all three reaches of Beauty Creek Flats the primary adjustment of the channels to an increased discharge is an increase in the width of the flow. It appears that the width exponent (b) may be used as an index of braiding intensity. On Beauty Creek Flats slope is an independent parameter and is not a significant influence in the nature of the anabranch adjustment. The hydraulic geometry relations determined for Beauty Creek Flats as a whole are compared to corresponding relations from other gravelly, glaciofluvial environments (Fahnestock, 1963; Church, 1972; and Arnborg, 1955). The comparison suggests that Arctic and non-Arctic outwash may be distinguished by the magnitude of the width and velocity exponents. The former is lower in an Arctic environment while the latter is higher. This suggests that there may be a similarity in channel response among areas of braided gravel outwash provided associated climatic conditions are similar. If additional data on channel adjustment on areas of gravelly outwash supports a similarity there may be potential for the development of a set of hydraulic geometry equations for each environment which could be used as predictors of channel behaviour.

063339
RICKETTS PJ (ED) * **Coastal studies in Canadian geography, Papers presented at a special session of the Canadian Association of Geographers Annual Conference, Corner Brook, Newfoundland, August, 1981** (see chapter 4.10 for complete reference - voir chapitre 4.10 pour la reference complete)

065152
ROTHWELL RL * **Erosion and sediment control at road-stream crossings** * For Chron * 59(2) 62-66 * 1983-04.

The effectiveness of a "brush mulch" to control erosion and sediment at road-stream crossings was evaluated by measurement and comparison of upstream and downstream suspended sediment. The brush mulch consisted of logging debris, such as branches, tree tops and logs 2-15 cm in diameter, laid on the ground to intercept and to slow overland flow and to trap sediment. Two treatments were defined and tested. Treatment no. 1 was a brush mulch and grass-fertilizer mixture applied by hydroseeding to three bare soil road-stream crossings. Treatment no. 2 was a grass-fertilizer mixture applied by hydroseeding to another three road-stream crossings. Total seasonal and storm sediment production for mulched and unmulched crossings averaged 31 and 37, and 566 and 2297 kg/day/ha, respectively. Tests showed significant differences between treatments for both seasonal and storm sediment production. The levels of significance were low because of high variability in sediment production among treatments and road crossings. Frequent onsite inspections during storm and nonstorm conditions, however, identified sources of variability and supported a final conclusion that the brush mulch was effective for erosion and sediment control at road-stream crossings.

065244
SINGH T * **A proposed method for preliminary assessment of erosion hazards in west-central Alberta** * Inf Rep NOR-X-251 * 17p * Environ Can, Can For Serv, Edmonton, Alta * 1983.

An infiltration-rated approach was used to indicate land units of high erosion susceptibility in west-central Alberta. Three main forest cover types lodgepole pine (Pinus contorta Dougl. var. latifolia Engelm.), spruce-fir (Picea glauca (Moench) Voss, Picea mariana (Mill.) B.S.P.-Abies lasiocarpa (Hook) Nutt.), and aspen (Populus tremuloides Michx.), were stratified according to soil delimitations based on surficial deposits. Infiltration determinations were made with constant-head double-ring infiltrometers. Five groups were identified as having very low, low, moderate, high, and very high erosion potentials. The average infiltration capacity in each forest cover type suggested low erosion susceptibility for lodgepole pine sites, very high susceptibility for spruce-fir forests, and moderate susceptibility for aspen forest. Such ranking of land units can serve as first approximations for planning purposes.

062875
WALL GJ, DICKINSON WT, GREUEL J * **Rainfall erosion indices for Canada east of the Rocky Mountains** * Can J Soil Sci * 63(2) 271-280 * 1983-05.

The use of the universal soil loss equation in Canada to estimate soil loss potential for soil and water conservation planning purposes has been limited by the lack of published rainfall erosion indices and by the arduous procedure generally accepted for determination of these indices. This study was conducted to

develop and test relatively simple methods to develop annual rainfall erosion indices and associated seasonal distribution patterns. An approach to the determination of a rainfall-runoff factor to accomodate the effect of winter conditions has also been included. The relatively simple techniques for estimating average annual rainfall erosion indices and seasonal distribution patterns of rainfall erosion have been found to yield comparable values to those determined by more tedious methods. These erosion indices and associated distribution patterns have proven useful for the development of a first approximation of rainfall erosion maps for Canadian locations east of the Rocky Mountains.

8. AGRICULTURAL HYDROLOGY - HYDROLOGIE AGRICOLE

064223
ALTA ENVIRON, POLLUT CONTROL DIV, MUNICIP ENG BRANCH * **Calgary region wastewater irrigation study** * 14p * Alta Environ, Pollut Control Div * 1982-04.

This report outlines a study to evaluate the feasibility of using municipal effluent for irrigation as a method of alleviating increasing irrigation water demands in the Calgary region as well as a means of alleviating concerns about sewage effluent discharges to the Bow River. To provide some insight into the magnitude of the project, a crude scenario of the project was developed and is explained. Some of the advantages and disadvantages of the proposal are discussed. Details of the three phases of the proposed study are listed, and a summary is given of the cost estimates.

F12147
BERNIER Y * **Impacts du drainage agricole sur l'environnement dans le bassin de la riviere Amyot**, IN: 4e colloque sur le traitement des eaux usees, 16-17 novembre 1981, Hotel Meridien, Montreal, Que * Environ Can, Serv prot environ; Assoc quebecoise tech eau; Soc quebecoise assai * 40p * 1981-11.

Le bassin de la riviere Amyot est situe sur la rive Sud du St-Laurent a environ 35 km au sud de l'embouchure de la riviere Richelieu et sur la rive droite de cette derniere. L'etude du milieu permet l'identification des forces dynamiques: les infrastructures existantes, les caracteristiques du milieu et les interventions des exploitants. L'etude d'impact avait pour but d'evaluer d'une facon systematique les impacts physiques, biologiques et humains induits par les amenagements hydrauliques du bassin versant de la riviere Amyot. Pour fin de cette presentation, deux impacts principaux pour examen detaille ont ete retenus, a savoir: l'aspect hydraulique afin d'evaluer l'impact du drainage sur le regime hydraulique de cette riviere; la qualite de l'eau qui permet de connaitre la consequence du drainage souterrain et superficiel sur la qualite de l'eau en fonction des habitudes culturales.

065123
CULLEY JLB, BOLTON EF * **Suspended solids and phosphorus loads from a clay soil: II. Watershed study** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

065124
CULLEY JLB, BOLTON EF, BERNYK V * **Suspended solids and phosphorus loads from a clay soil: I. Plot studies** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

065114
DICKISON RBB, DAUGHARTY DA * **The effects of snowmelt runoff of the removal of forest cover** * 20p * 1982.

Two small watersheds in central New Brunswick, Canada were studies for several years prior to and since a commercial clearcut harvest in 1978. Post-treatment seasons have been characterized by below-normal snowcover, but evidence clearly shows the de-dynchronization of snowmelt runoff between the cleared and forested watersheds. The treatment has probably caused a reduction of the annual peak flow, which almost always occurs during the snowmelt period. The variability of hydrologic events at this season, however, suggests that specific results require cautious interpretation.

063683
EDDIE JD * **Temporal variation of southwestern Ontario streamflows and the possible influence of agricultural land drainage** (see chapter 4.1 for complete reference - voir chapitre 4.1 pour la reference complete)

063255
ENVIRON COUNC ALTA * **Irrigation agriculture in Alberta** * 74p * Environ Counc Alta, 8th Floor, Weber Cent, 5555 Calgary Trail, Edmonton, Alta T6H 5P9 * 1982-03.

This report examines the premise that increases in production due to irrigation can offset the decreases in production attributable to decreases in the size and capability of the agricultural land base in Alberta. The present context of irrigation in the province is described including the location and extent of irrigated land, irrigating the soil, methods of irrigation, relationship of irrigation to agriculture, and

products grown on irrigated land. Environmental concerns related to irrigation, notably soil salinity and effects on water quality, are described. The economics of irrigation are also examined with reference to the benefit/cost analysis of water management projects and distribution of benefits. Prospects for increasing the acreage of land under irrigation and alternatives for increasing the requisite supply of water including the availability of water, and constraints on the use of water for irrigation, are examined. Conclusions are then drawn about the future role of irrigation in Alberta.

065851
FORTIN M * **Cropping-income impacts of management measures to control soil loss** (see chapter 7.2 for complete reference - voir chapitre 7.2 pour la reference complete)

062852
GLASGOW WM * **Fisheries and wildlife resources and the agricultural land base in Alberta** * 65p * Environ Counc Alta, 8th floor Weber Cent, 5555 Calgary Trail, Edmonton, Alta T6H 5P9 * 1982-07.

The Environment Council of Alberta is conducting public hearings on "Maintaining and Expanding the Agricultural Land Base in Alberta." The purpose of this report is to discuss the fish and wildlife resources that live in agricultural Alberta. This area provides the only habitat in the province for some species of fish and wildlife like the pronghorn antelope. It also has most of the important habitat in Alberta for species such as waterfowl and white-tailed deer. The fish and wildlife resource provided an estimated 6.5 million angler days and 0.9 million hunter days of recreation in 1980. This represented an estimated value of $432 million in goods and services attributed to recreational fishing and $77 million attributed to recreational hunting in 1980. Agricultural practises such as clearing, draining, cultivating, irrigating, damming water courses, pesticide spraying, fertilizing, crop harvesting, and livestock grazing all modify fish and wildlife habitat to varying degrees. The effect of these habitat modifications on fish and wildlife populations can be beneficial but has become very detrimental in many agricultural areas of Alberta in recent decades. Fish and wildlife and agricultural managers must follow the principles of wise land use and work together to ensure the long-term security and productivity of both their resources. Techniques to overcome management problems and maintain fish and wildlife resources in agricultural Alberta are discussed.

F11942
GOSSELIN Y * **Problemes et solutions, l'environnement agricole** * Ing * (359) 11-16 * Les Publ l'Ingenieur Inc, Montreal, Que * 1984-01.

Dans cet article, on presente un certain nombre de preoccupations suscitees par les activites du secteur agricole, en ce qui concerne la qualite de l'eau. Les objectifs realistes de qualite de l'eau souterraine et de surface, en vue de proteger et meme d'ameliorer notre environnement peuvent etre de deux ordres: les objectifs de preservation du milieu et les objectifs economiques. Les principaux problemes peuvent etre regroupes en quatre grands secteurs d'activite: les productions animales; les productions vegetales; les amenagements hydro-agricoles; la gestion des residus d'exploitation. Les mesures necessaires a prendre afin de reduire la pollution agricole sont: ameliorer, restaurer et conserver la qualite des eaux; restaurer et maintenir l'equilibre des milieux aquatiques; eviter les concentrations d'elevage; augmenter les structures existantes; revaloriser les dechets et sous-produits agricoles; eviter les cultures intensives; eviter la degradation des plans d'eau; reduire au minimum l'uniformisation du milieu hydrogaphique.

065847
GRAHAM A, KNIGHT G * **The controlled access of livestock to open watercourses** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

065505
GRAVELAND DN * **Irrigation water quality study of Etzikom Coulee** * 15p * Alberta Environ, Environ Prot Serv, Earth Sci Div, Tech Dev Branch * 1980-12.

A water quality study of the Etzikom Coulee system was initiated to determine the advisability of increasing irrigation development in the Crow Indian section of the Coulee. Analyses of samples taken over a one-year period indicate that the salt content of the Etzikom Coulee water continuously increased from the point of origin (Stirling Lake) to Crow Indian Lake. The water in Crow Indian Lake and downstream of the Lake is unsuitable for irrigation because of high concentration of sodium and other salts.

066085
HENDRY MJ * **Hydraulic response of irrigating a slowly permeable tile-drained soil** (see chapter 5.1 for complete reference - voir chapitre 5.1 pour la reference complete)

062461
IHNAT M * **Copper, zinc, cadmium and lead in waters of selected southern Ontario**

agricultural watersheds (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

061886
JAME YW, NICHOLAICHUK W, LEYSHON AJ, CAMPBELL CA * **Boron concentration in the soil solution under irrigation: a theoretical analysis** (see chapter 5.2 for complete reference - voir chapitre 5.2 pour la reference complete)

066189
JOSEPH HC * **A study of heavy metal transport in irrigation return flows of southern Alberta** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

065926
LAKSHMAN G * **Surface water pollution from intensive livestock operations** . IN: Cattle feedlot workshop Proc, Dec 8-9, 1981, Alberta Environmental Cent, Vegreville, Alta * QURESHI AA, COLEMAN RN * AECV82-P1 * 30-48 * Alta Environmental Cent, Vegreville Alta * 1982.

Intensive livestock operations have come increasingly under harsh criticism, that they are responsible for unabated discharges of pollutants into our surface waters. The following analysis of surface water pollution from feedlots is based on the field data collected from a study conducted by the Saskatchewan Research Council for the Family Farm Improvement Branch of Saskatchewan Agriculture. The study obtained the field data from the livestock operations in the Qu'Appelle Basin during the years 1975 to 1978. An attempt is made to delineate the processes responsible for surface water pollution in feedlots and to recommend methods to minimize environmental danger. Significant factors determining the potential of pollution from livestock operations fall into the following categories: feedlots; manure disposal areas; manure characteristics; transport parameters. Important factors that affect surface water pollution from feedlots and manure spreading areas are: isolation distance; land slope; initial concentration of nutrients; and quantity of runoff.

066695
LORBERG EF * **Groundwater component of the South Saskatchewan River basin in Alberta** (see chapter 5.1 for complete reference - voir chapitre 5.1 pour la reference complete)

065928
MINER JR * **Cattle feedlot microbiology, an overview** . IN: Cattle feedlot workshop Proc, Dec 8-9, 1981, Alberta Environmental Cent, Vegreville, Alta * QURESHI AA, COLEMAN RN * AECV82-P1 * 9-29 * Alta Environmental Cent, Vegreville, Alta * 1982.

The cattle feedlot surface may be viewed as a dynamic microbiological reactor which is being continuously impacted by a series of physical and chemical forces. Whatever the ultimate disposition these reactions are critically important to any quantitative planning process. Cattle manure as it reaches the feedlot surface is a function of the ration being fed and to a lesser intent the management regime. Microbiological characterization of cattle waste is more limited. Table 2 summarizes those data. Cattle feedlot runoff is a typical hydrologic process which is amenable to standard analysis. The process is one in which the feedlot surface stores the initial rainfall, then once the storage capacity is reached, overland flow will begin. The factors which have been identified to have an influence on the quality of cattle feedlot runoff are: rainfall intensity, rainfall quantity, temperature, antecedent moisture and lot surface. In order to demonstrate the ability of the model to predict runoff and retention basin quality a simplified weather pattern was specified in which constant monthly temperatures were assumed and discrete rainfall events were specified.

063506
NICHOLAICHUK W, GROVER R * **Loss of fall-applied 2,4-D in spring runoff from a small agricultural watershed** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

062009
OOSTERVELD M, NICHOLAICHUK W * **Water requirements, availability and development restraints for increased crop productivity in Canada** * Can J Plant Sci * 63 (1) 33-44 * 1983-01

When crop productivity is restricted because of the availability of water, the amount of water required to remove the limitation is known as the soil water deficit. Most regions of Canada have a water deficit even though annual precipitation may appear more than sufficient for maximum needs. Soils have insufficient storage capacity to take crops through extended periods without rain. All crops will suffer from a water deficit, but the impact on yield varies among species and the timing of the stress. Similarly, supplemental irrigation to eliminate the deficit results in varying yield response, depending on the severity and timing of stress. The greatest potential response from irrigation occurs in the southern Prairies and the interior valley in British Columbia. Productivity per unit areas can be increased at least 400%. The long-term limitation to development on the prairies is a regional water shortage, which can only be overcome by huge investments in water diversions from

north-flowing rivers. Irrigation development in Ontario is presently economically attractive and water sources can be developed locally. It is expected that geometric growth in irrigation development will take place, particularly if several dry years occur in succession. In the most humid portions of Canada, encompassing the five eastern provinces, irrigation development is likely to be limited to small areas of fruit and specialty crops where a small increase in yield justifies the cost of irrigation equipment.

063571
PRAIRIE PROV WATER BOARD * **Water demand study, Historical and current water uses in the Saskatchewan - Nelson Basin. Appendix 3, Agricultural water uses** (see chapter 4.11 for complete reference - voir chapitre 4.11 pour la reference complete)

062845
SANDERSON K * **Irrigation agriculture in Alberta: summary** * 10p * Environ Counc Alta, 8th floor Weber Cent, 5555 Calgary Trail, Edmonton, Alta T6H 5P9 * 1982-02.

This summary of a more detailed report describes: irrigation agriculture in Alberta, including types of crops grown, extent of irrigation, and irrigation techniques; concerns related to irrigation, including soil salinization and effects on water quality; economics of irrigation; expansion of irrigated acreage; supply of water for irrigation; and, the future of irrigation in Alberta. It is shown that irrigation agriculture is currently making a significant contribution to agricultural production in Alberta and that irrigation could be expanded to partially offset loss of production from non-agricultural use of land. This expansion is not to be regarded as a long-term solution to the loss of productive agricultural land.

065353
WALLIS CH, BLACK TA, HERTZMAN O, WALTON VJ * **Application of a water balance model to estimating hay growth in the Peace River Region** (see chapter 2 for complete reference - voir chapitre 2 pour la reference complete)

065927
WEST B * **Cattle feedlot manure management: code of practice**, IN: Cattle feedlot workshop Proc, Dec 8-9, 1981, Alberta Environmental Cent, Vegreville, Alta * QURESHI AA, COLEMAN RN * AECV82-P1 * 74-88 * Alta Environmental Cent, Vegreville, Alta * 1982.

This paper summarizes the Code of Practice as it applies to beef feedlot manure management. The Code of Practice sets out guidelines and recommendations as an aid to the establishment and development of the livestock with the best possible manure management systems. The purpose and intent of the Code of Practice as well as the guidelines for good practice are summarized.

9. FOREST HYDROLOGY - HYDROLOGIE FORESTIERE

064063
BARRY B * **Acid rain and forest productivity** * 5p * 1982.

This article, in the form of an interview conducted with Dr. Gilles Robitaille of Environment Canada's Laurentian Forest Research Centre in Quebec,explains the objectives, experiments and findings to date of studies conducted to determine the effects of acid rain on forest ecosystems in the Lake Laflamme catchment basin in Montmorency Forest, Quebec. The objective of the study is basically to observe the present state of an ecosystem, in this case, an entire watershed including the forest, the soil and the lake, with respect to the acid deposits presently there. Measuring instruments set up to measure the input of acidifying substances, sulphates and nitrates, the pH of the precipitation, both snow and rain, the chemical composition of the rain water when it reaches the ground, after it has filtered through the soil, when it goes into the lake and when it leaves the lake, and composition and amounts of dry deposits, are described. Laboratory experiments conducted on soil under simulated conditions, are discussed, focusing on impoverishment of the forest soils resulting from the leaching of nutrients by acid precipitation. A brief outline of the effects of acid deposits on the soil and on vegetation, is also presented.

065738
BEAUDRY P, GOLDING DL * **Snowmelt during rain on snow in coastal British Columbia** (see chapter 6.2 for complete reference - voir chapitre 6.2 pour la reference complete)

063523
CHANASYK DS, VERSCHUREN JP * **An interflow model: II. Model validation** (see chapter 4.1 for complete reference - voir chapitre 4.1 pour la reference complete)

063273
CHANASYK DS, VERSCHUREN JP * **An interflow model: I. Model development** * Can Water Resour J * 8(1) 106-119 * 1983.

Field studies in forest hydrology, conducted over the past 15 years, have shown that interflow is the major flow process on forested, mountainous watersheds. Existing hydrologic models cannot be rigorously applied

to these watersheds because of the empirical treatment of interflow in these models. A hydrologic model, called the SLUICES (Soils and Land Use affecting Interflow and Creating Effects on Streamflow) model, was developed to overcome these limitations. The model emphasizes the dominance of interflow, is distributed in nature and yet is simple in structure, containing only seven easily obtainable or optimized parameters. A study was conducted to evaluate the sensitivity of model parameters.

067022
CULP JM, DAVIES RW * **An assessment of the effects of streambank clear-cutting on macroinvertebrate communities in a managed watershed** * Can Tech Rep Fish Aquat Sci 1208 * 130p * Dep Fish Oceans, Fish Res Branch, Pac Biol Stn, Nanaimo, BC V9R 5K6 * 1983-10.

Three macroinvertebrate sampling sites were established on Carnation Creek, Vancouver Island, British Columbia, and sampled from 1974-1980 to determine the effects of logging, with or without buffer zones, on macroinvertebrate communities. Logging without a buffer zone increased streambank erosion and the resulting sedimentation of streambank material caused a significant increase in the proportion of less than 9 mm sediment particles in the substrate. Although logging opened the forest canopy and increased the light available for primary production, algal biomass did not increase after logging because phosphorus remained the limiting factor. Allochthonous litter input to the stream was significantly reduced at both logged sites, but the site with a buffer zone provided greater amounts of leaf litter to the stream, and had a higher post-logging benthic standing crop than the site without a buffer zone.

062418
DAUGHARTY DA, DICKSON RBB * **Snow cover distribution in forested and deforested landscapes in New Brunswick, Canada (see chapter 6.2 for complete reference - voir chapitre 6.2 pour la reference complete)**

F11528
DELISLE A * Viser la foret pour proteger l'eau * For-Conserv * 50(7) photo * 1983-11.

La foret qui l'encadre constitue une protection indispensable pour tout plan d'eau. Depuis 1970, le probleme du deboisement des rives et de ses effets sur la qualite de l'eau est connu et pris en charge par une equipe bien speciale du ministere de l'Environnement. Le Conseil consultatif de l'Environnement publiait recemment une etude elaboree sur cette question, s'attachant a son aspect forestier. Intitule "Politique d'encadrement forestier des lacs et des cours d'eau", le document du Conseil aborde le probleme d'une maniere globale, en faisant ressortir les relations entre la couverture forestiere et le comportement hydrologique des cours d'eau. Pour le Conseil consultatif de l'Environnement, il est clair que ce n'est pas a court terme que le gouvernement se dotera d'une politique d'encadrement forestier des lacs et cours d'eau du Quebec.

066755
FREEDMAN B * **Environmental impacts associated with increased harvesting and burning of wood for energy purposes in Nova Scotia** * 116p * Inst Resour and Environ Studies, Dalhousie Univ, Halifax, NS * 1981.

The potential for the use of forest biomass as a source of industrial or residential energy is favourable in Nova Scotia. There is presently a large excess of hardwood supply. The harvesting and use of these forests could have a number of environmental effects such as nutrient impoverishment of sites, poor regeneration, erosion, changes in the hydrology of sites, losses of wildlife habitat and effects on aesthetics and recreational opportunities. Air pollution from wood combustion also presents a threat to the environment. This report assesses these problems with respect to the Nova Scotia situation and recommendations are made on ways in which some of these environmental effects of forestry practices can be reduced or eliminated.

066158
GRANBERG HB * **Snow sampling bias in the boreal forest** (see chapter 6.2 for complete reference - voir chapitre 6.2 pour la reference complete)

063272
MATHERS T, TAYLOR CH * **Rainfall interception on a small forested watershed within the Kawartha Lakes region** * Can Water Resour J * 8(1) 120-129 * 1983.

Interception and precipitation data were collected on a small, mixed forested watershed in the Kawartha Lakes region of east-central Ontario. Measurements were taken from September 13, 1977 to September 12, 1978, in an effort to quantify the effects of vegetation on the disposition of precipitation. Regression equations were developed to describe the atmospheric and surface characteristics influencing interception. From these equations, approximately 12% of gross rainfall is intercepted and returned to the atmosphere. It is hoped that these results will assist in the construction of detailed water budgets for the region and other areas of similar hydrologic behaviour.

F11279
PERREAULT, LAROUCHE, HOUDE & ASSOC, SOC ING FOR * **Amenagement forestier d'un bassin hydrographique municipal. Vol. 3: Ville de Beaupre** (P.Q) * vp * Perreault, Larouche, Houde & Assoc, Que * 1980-12.

L'approvisionnement en EAU de la ville de Beaupre provient du bassin hydrographique de la Riviere-aux-Chiens. Cette EAU repond bien aux besoins tant du cote qualite que du cote quantite. L'etude donne des moyens pour conserver cette ressource par l'amenagement forestier du bassin en prescrivant des travaux sylvicoles qui tiennent compte de la vocation du territoire et des types de proprietaires.

F11281
PERREAULT, LAROUCHE, HOUDE & ASSOC, SOC ING FOR * **Amenagement forestier d'un bassin hydrographique municipal. Vol. 1: Principes de base** * vp * Perreault, Larouche, Houde & Assoc, Que * 1980-12.

Cette etude sur l'amenagement forestier de bassin hydrographique municipal constitue l'aboutissement de trois ans de recherches preliminaires menant a un schema de proposition. La proposition qui a ete acceptee en date du 1er avril 1980 comportait trois volets. Le premier se veut une presentation et une sensibilisation au sujet. L'objet du premier volet, ou volume 1 est, en fait la presentation d'une gamme de problemes pouvant etre rencontres dans un bassin hydrographique municipal afin de demontrer certains principes de base. Le second volume se veut une standardisation de l'amenagement forestier de bassins hydrographiques. C'est le schema d'un plan d'amenagement dans lequel les formules mathematiques adaptees au bassin sont demontrees et ou les principes de base retenus sont enonces. C'est donc un outil standardise pour l'amenagiste forestier oeuvrant plus specifiquement dans le domaine de l'approvisionnement en eau d'une municipalite. Enfin, le troisieme volume est le plan d'amenagement forestier d'un bassin hydrographique municipal. C'est l'etape laboratoire du volume deux.

F11280
PERREAULT, LAROUCHE, HOUDE & ASSOC, SOC ING FOR * **Amenagement forestier d'un bassin hydrographique municipal. Vol. 2** * vp * Perreault, Larouche, Houde & Assoc, Que * 1981-01.

La preparation d'un plan d'amenagement pour un bassin hydrographique municipal est complexe. Ce travail necessite la recolte, l'analyse et la synthese d'une grande quantite de donnees. Ce document donne une methode a suivre dans le but de definir et d'evaluer les parametres decrivant la foret, les aspects physiques du bassin, les utilisations du territoire et les besoins en eau de maniere a identifier les limites d'amenagement.

10. DRINKING WATER - EAU POTABLE

062610
GROVER B * **Canadian roles in the International Drinking Water Supply and Sanitation Decade** . IN: Environmental Government Affairs Seminar, Proc, Environmental Concerns of the 80's, October 12-15, 1982, Ottawa, Ont * 471-486 * Air Pollut Control Assoc and Fed Assoc Can Environ * (1982).

Canada has been an active promoter of the International Drinking Water Supply and Sanitation Decade, whose goal is to provide these basic services to all people in the period 1981-1990. This implies providing improved services to roughly 2,000 million people in the developing countries in ten years, a noble but unattainable goal. However, the Decade could provide a major stimulus to the accelerate the provision of services to meet the basic needs of millions of people. Almost all of Canada's 25 million people are reasonably well provided with water supply and sanitation. These services are mostly provided at the local level by an industry which is highly decentralized and loosely organized. This industry, with an estimated 40,000 employees across the country, has hardly focussed on the opportunities for utilizing Canadian experience and resources to support sector programs in the developing countries. The Canadian International Developing Agency continues to provide assistance on a modest scale for a number of activities related to water and wastewater projects. Despite vocal support for the Decade, however, there is no evidence that Canada is providing much more support for water and sanitation programs in the 1980's than it did in the 1970's. The paper discusses various Canadian roles in sector programs in the developing countries and suggests a possible means for improving Canadian participation in Decade activities.

062615
HICKMAN JR * **Drinking water quality and health protection** . IN: Environmental Government Affairs Seminar, Proc, Environmental Concerns of the 80's, October 12-15, 1982, Ottawa, Ont * 438-446 * Air Pollut Control Assoc and Fed Assoc Can Environ * (1982).

In recent years, advances in analytical methods and their application to drinking water has resulted in the detection of a vast number of chemical compounds that had previously gone unnoticed, many of which are known to have toxic properties. A list is given of the origins of chemicals commonly occurring in drinking water and a table presents the contribution of drinking water to the total daily intake for Canadians of toxic substances. In a discussion of tap-water consumption in Canada two general factors are considered: the quantity of water consumed and water use habits. In order to obtain

relevant Canadian data on tap-water consumption and use patterns. a survey was undertaken in 1977-78 which showed that there were significant regional differences in tap-water consumption. Recently, concern has been expressed about the occurrence and potential toxicity of organic contaminants in groundwater, especially in the United States and the Netherlands. The need for a national analytical service is discussed and recent mutagenicity screening studies are noted.

063660
INFOTERRA PROGRAMME ACT CENT, UNITED NATIONS ENVIRON PROGRAMME • **Drinking water supply and sanitation, information sources** • 232p • INFOTERRA Programme Act Cent, United Nations Environ Programme, PO Box 30552, Nairobi, KE • 1982.

INFOTERRA is a decentralized international network incorporating diverse environmental information systems. It operates through a grid of government-designated national focal points. INFOTERRA national focal points refer those in need of information to sources best able to provide such information. This resource book presents a variety of institutional and bibliographic sources of technical, economic and other information on drinking water supply and sanitation. Its first part comprises the INFOTERRA sources and Index, a selected listing and brief description of 400 institutions registered in the INFOTERRA international directory, chosen for their ability to supply information. The second part is a selected bibliography of publications, prepared by the United Nations Environment Programme (UNEP) Water and Soil Task Force and by the WHO International Reference Centre for community water supply.

062835
ROBERTS J • **Roberts calls for drinking water review as toxic chemical contamination increases** • 4p • Minist. Environ Can • 1983-06-06.

Environment Minister, John Roberts, calls on all governments to assess water treatment in the Lake Ontario Basin, the source of drinking water for 4 million Canadians. Chemical contamination in the lake has been slowly increasing. New findings of contamination, based in part on improved analytical methods, are occurring faster than toxicologists can develop standards. Mr Roberts will convene a high level meeting of federal, provincial and municipal agencies, to review the latest scientific information on health guidelines, priority toxic substances, existing water purification measures, and current technology practised in other industrial areas. He states Canada's position on: the Hyde Park and "S" Area Landfill Sites, Love Canal, and the Niagara Falls Wastewater Treatment Plan. For more information, contact Maureen Nartinuk, Toronto, (416) 966-6406; or Marcel Pronovost, Ottawa, (819) 994-1410.

062616
SOMERS E • **Drinking water in Canada: "the federal perspective"** . IN: Environmental Government Affairs Seminar, Proc, Environmental Concerns of the 80's, October 12-15, 1982, Ottawa, Ont • 430-437 • Air Pollut Control Assoc and Fed Assoc Can Environ • (1982).

An overview is presented of the development of a national program on drinking water quality, the jurisdictional authority on which this is based, and of some of the governments current studies. The responsibilities of the various levels of government with regard to water supplies are reviewed briefly and some historical background on federal standards for drinking water is given. In response to concerns expressed for organic contaminants in water, a Federal/Provincial Working Group on Drinking Water Quality is to be established and their evaluation completed within a year. The federal government works closely with the World Health Organization (WHO) on the revision of the 1971 WHO International Standards for Drinking Water. These guidelines provide action limits for a number of organic chemicals such as chlorobenzenes, benzene, benzo-a-pyrene, and some pesticides. Point-of-water treatment devices are discussed, with the emphasis on carbon filters. Although the bacterial contamination of drinking water is regarded as well-controlled it is not certain that the same situation holds for viruses. Recent reports of the presence of enteric viruses in finished Canadian drinking water are discussed. The federal government is currently funding research studies designed to study viruses in drinking water. A review of the association between illnesses and recreational waters has been prepared and a recommendation made that national guidelines for recreational waters should be developed. The government has also supported a two-year epidemiological study on selected Great Lakes beaches. The results are not complete, however it is clear that there is an association between swimmers' illness and entero-viruses, staphylococci, and fecal coliforms.

11. ENVIRONMENTAL IMPACT ASSESSMENT - CONSTATS D'IMPACT

062606
Environmental Government Affairs Seminar, Proceedings, Environmental Concerns of the 80's, October 12-15, 1982, Holiday Inn, Ottawa, Ontario • 505p • Air Pollut Control Assoc and Fed Assoc Can Environ • (1982).

The papers were presented to the

Environmental Government Affairs Seminar of the Air Pollution Control Association (APCA) and the Federation of Associations of the Canadian Environment (FACE). Session 1 dealt with federal-provincal-industry-public interface concerning environmental problems in the 1980's. Session 2 dealt with the environmental impact assessment process in Canada. The evolution of the process was discussed and suggestions made as to how the process should evolve. Papers presented in Session 3 outlined a number of viewpoints on transboundary pollution including those of industries and of provincial governments. Issues relating to boundary water problems and to acid precipitation were discussed. Session 4 dealt with hazardous substances and included a discussion of Environment Canada's Toxic Chemicals Management Program and of the regulation of hazardous substances under the Transportation of Dangerous Goods Act. Attention was given to the problems involved in the siting of industrial toxic waste treatment centers. The industrial and public viewpoints on the subject was given. Session 5(A) dealt with environmental problems associated with motor vehicles. Papers in Session 5(B) discussed issues relating to water supply and water quality in Canada with the session title being "Water - A Manageable Resouce of the 80's.

065866
ALBERTA ENVIRON, ENVIRON ASSESS SECT, PLANN SERV BRANCH, PLANN DIV • **Paddle River Dam environmental impact assessment** • 3v • Alberta Environ, Plann Div • 1981-11.

This report describes the technical studies carried out, and provides an assessment of the environmental impact of constructing a dam and operating a flood control reservoir on the Paddle River. Volume I, the main report, describes the construction of the project, both settlement and resource-based land use, geology and soils, vegetation, wildlife, fisheries, air, water, and the effects of the dam on the community. Volume II consists of appendices on: project development and related activities; land use; historical resources; wildlife; and geology and soils. Volume III, consists of appendices on: vegetation; fisheries, water resources management; hydrology; and community. It is concluded that the impacts of the project will be minor. There will, however, be some loss of farmland and wildlife habitat. The project will provide some increased recreational opportunities within the region, with recreational development being incorporated into site rehabilitation following construction. Some land will be acquired for possible future provincial park development. Mitigation and monitoring measures for reducing negative effects of the project are outlined.

063066
BANKES N, THOMPSON AR • **Monitoring for impact assessment and management: an analysis of the legal and administrative framework** • 80p • Westwater Res Cent, Univ BC, Vancouver, BC V6T 1W5 • 1980.

This study analyzes impact assessment and decision-making as a dynamic, on-going process focussing on the post-approval elements. It is assumed that requirements for social, economic, and environmental assessment of impacts of projects are here to stay, that they represent a substantial commitment of public and private resources, and that it is important to make them work effectively. It is also assumed that public participation is an integral part of such a requirement. The nature of major development projects and the problems they present for impact assessment and decision-making are examined. The legal and institutional requirements of an effective monitoring program are studied including contract and statutory law. Two case studies of actual Canadian experiences are included as appendices. A case study is presented of a monitoring program carried out in the case of the B.C. Hydro Revelstoke dam and power generating station. Recommendations are offered as to when and how monitoring should be incorporated as part of the overall process of project impact assessment and decision-making.

065699
BEANLANDS GE, DUINKER PN • **An ecological framework for environmental impact assessment in Canada** • 132p • Inst Resour Environ Stud, Dalhousie Univ, Halifax, NS and Fed Environ Assess Rev Off • 1983.

This report considers the extent to which the science of ecology can contribute to the design and conduct of environmental impact assessment studies and it recommends ways in which this can be achieved. Background information to the study is presented and a review is given of selected assessments. The study findings on improving the contribution that ecological science can make to environmental impact assessment are presented. This involves two distinct aspects. On the one hand are the principles and methods of acceptable scientific practice, which essentially are shared by most other natural science disciplines. The other involves ecological principles and theory which are peculiar to the discipline of ecology. The former are elucidated in the context of ecological study as part of the environmental assessment. Ecological principles and theory as they may contribute to the design of assessment studies and to impact prediction are considered. A basic set of requirements for impact studies in support of environmental assessment are presented and recommendations are made pertaining to the administrative and institutional aspects of impact assessment. Throughout the report emphasis is given to the

use of examples to demonstrate the utility and practicality of the various concepts and approaches discussed.

064483
CLARK SD (ED) • **Environmental assessment in Australia and Canada** . IN: Workshop on Environmental Assessment, Univ Melbourne, Ormond Coll, AU, Feb 1981 • 535p • Univ British Columbia, Westwater Res Cent, Vancouver, BC • 1981.

A workshop on Environmental Assessment in Australia and Canada was held in 1981 at the University of Melbourne Law School. It was organized to compare and evaluate the accumulated experience in formulating policy and implementing environmental assessment procedures in Australia and Canada.

066699
COOPER R • **Cooperation and concerns, Flathead River basin Montana and British Columbia** . IN: Third Biennial Plains Aquatic Research Conf, Proc, August 24 and 25, 1983, Montana State Univ, Bozeman, Mt • SCOTT MD • Can Plains Proc 11 • 215-221 • Inst Nat Resour, Dep Earth Sci, Montana State Univ and Can Plains Res Cent, Univ Regina • 1983.

The Flathead River Basin in northwest Montana and extreme southeastern British Columbia is an area being managed with opposing objectives. While Montana and the United States have increasingly recognized conservation, British Columbia has viewed this area as an important area for increased resource development. The proposed Cabin Creek coal mine has brought this situation to a head. Information exchanges have been very successful in providing a means to conduct nonadversarial discussions which allow for informal local input, facilitate the flow of information, make each other aware of respective resource management processes and long-term objectives. Lessons learned from the Flathead information exchanges indicate that these exchanges could be useful in assisting in the resolution of other transboundary disputes.

063065
COUCH WJ (ED) • **Environmental assessment in Canada, 1982 guide to current practice** • IIIp • Can Counc Resour Environ Minist • 1982-07.

A brief overview is given of some of the main features of environmental assessment in Canada. This is followed by a more detailed examination of environmental assessment in each jurisdiction, beginning with the federal government. The mandate and responsibilities, and the procedures followed are outlined. Contact persons are listed for each jurisdiction if further information is required. The final section of the publication consists of detailed process descriptions for each jurisdiction. The legal instrument for environmental impact assessment in each jurisdiction is reviewed and government policy and procedures are described. The administration of the process is described and the implementation and enforcement procedures are reviewed. At the conclusion of each governmental section is a list of reference documents.

063061
COUCH WJ (ED) • **Environmental assessment in Canada, 1983 summary of current practice** • 41p • Can Counc Resour Environ Minist • 1983-04.

This document is a revision of a booklet entitled "Environmental Assessment in Canada: 1982 Summary of Current Practice". The publication presents an overview of how environmental assessment is applied in each jurisdiction in Canada. A brief summary is given of environmental assessment in Canada today, showing similarities and suggesting emerging trends. Process summaries are presented with concise descriptions of how each government carries out environmental assessment. The mandate and responsibilities are reviewed and procedures are outlined. Sources of additional information within each jurisdiction are listed.

065698
DUINKER PN, BEANLANDS GE • **Ecology and environmental impact assessment: an annotated bibliography** • 40p • Inst Resour Environ Stud, Dalhousie Univ, Halifax, NS and Fed Environ Assess Rev Off • 1983.

This annotated bibliography is a companion volume to the final report for a study on the ecological basis for environmental impact assessment in Canada entitled "An Ecological Framework for Environmental Assessment in Canada". This volume describes literature available on various topics related to the application of ecological science in environmental assessment. Specific topics covered in the bibliography are listed in a subject index and reflect the range of topics discussed at the technical workshops and analyzed in the final report of the study.

061930
ENVIRON ASSESS PANEL, FED ENVIRON ASSESS REV OFF • **Alaska Highway Gas Pipeline Project, Technical hearings (June 7-12, 1982), Final report of the Environmental Assessment Panel** • Fed Environ Assess Rev Process 21 • 28p • Environ Assess Rev, 13th Floor, Fontaine Build, Hull, Que K1A OH3 • 1982-09.

This report conveys the conclusions and recommendations of the Environmental Assessment Panel following the review of additional information required by the Panel and submitted by Foothills Pipe Lines (South Yukon) Limited as addenda to the 1979 Environmental Impact Statement for the Alaska

Highway Gas Pipeline. The Panel reviewed the proposal by Foothills Pipe Lines to construct the Yukon section of a large-diameter gas pipeline from the Alaska north slope to the lower 48 states of the United States. The Panel convened technical hearing in Whitehorse to receive briefs and comments on Foothills technical documents. It concluded that the preliminary environmental planning on the project is generally adequate. However, recommendations on several specific concerns are presented in this report. The geotechnical difficulties associated with frost heave and thaw settlement are better understood and design option have been developed which may overcome the problems. This applies to hydrology and revegetation issues as well. The project sponsors have recently announced a two-year delay in the project, with a new start-up date in late 1989. The Panel suggests that the additional two-year delay in the project now offers a more satisfactory time frame in which to address the recommendations contained in this report. Most of the recommendations are directed to the Northern Pipeline Agency which has the primary responsibility for project regulation and surveillance.

065626
ESSO MINERALS CANADA * **A reclamation plan for the Gays River lead/zinc mine** (see chapter 4.16.1 for complete reference - voir chapitre 4.16.1 pour la reference complete)

063777
FOSTER LT, DONNAN JA * **Measuring environmental intangibles: concepts and application, Chapter 18** , IN: Water problems and policies * SEWELL WRD, BARKER ML * Cornett Occas Pap No 1 * 199-213 * Dep Geogr, Univ Victoria, Victoria, BC V8W 2Y2 * 1980.

This paper asserts the ability to explicitly consider environmental consequences of resource development projects in a systematic and quantitative manner. A conceptual classification of intangible consequences is presented, which is intended to facilitate the practical application of the techniques which have been developed to evaluate them. A practical approach undertaken by the Ontario Ministry of the Environment to measure and evaluate environmental benefits related to pollution abatement investments in the pulp and paper industry in Ontario is described.

067044
HARDY ASSOC (1978) LTD, CALGARY, ALBERTA * **Report on geology and soils, appendix D** , IN: Paddle River Dam environmental impact assessment * v2 19p * Alta Environ, Plann Div * 1981-11.

This study was undertaken to describe the existing bedrock, Quarternary geologic materials, and soils in the reservoir area. The information collected in these office and field studies served as a basis for identifying the potential impact that design, construction, operation, and maintenance of the dam would have on the physical environment. Recommendations for measures required to reduce and monitor erosion of surface materials in the reservoir area and borrow pits were proposed. Furthermore, reclamation of borrow pits has also been considered.

064095
JACK ME, OSLER TR * **Baseline study of the watersheds near the Jason Property, Macmillan Pass, Yukon Territory** * Reg Prog Rep No 83-08 * 71p * Environ Can, Environ Prot Serv, Pac Reg, Yukon Branch * 1983-07.

A predevelopment study was undertaken by the Environmental Protection Service in the watersheds near the Jason Property in MacMillan Pass, Yukon in July, 1981. The presence of ore minerals in the study area was reflected by their presence in water and sediment. The metals of concern when a mine and mill become active will be arsenic, barium, cadmium, copper, manganese, nickel, silver, lead and zinc. The water courses in the area have soft waters with low buffering capacity. The numbers of bottom fauna collected were low.

067045
LINDNER DH * **Paddle River Dam, project development and related activities, appendix A** , IN: Paddle River Dam environmental impact assessment * v2 32p * Alta Environ, Plann Div * 1981-11.

The Paddle River dam and reservoir will provide flood control up to a 1 in 8 year flood for about 50 km of floodplain used for agriculture. This status report summarizes features of the dam, reservoir, outlet system, spillway and related works. The focus is on field activities related to design already in progress or to be undertaken in the near future, construction activities for the period from 1981 to 1984, and subsequent long-term operation and maintenance activities. In this manner the impact of the Paddle River flood control project on the environment is identified.

063296
MACLAREN PLANSEARCH * **Environmental concerns double tracking West Portal to Mile 91.8, Rogers Pass Project** * 45p * 1983-03.

CP Rail is currently constructing a tunnel and a surface section of new track through Rogers Pass in Glacier National Park. This report describes the project and the area to be affected, identifies the environmental concerns, and suggests possible mitigative measures. CP Rail plans to use the material

from the western half of the tunnel to construct a second track from the west portal westward to the current double track. A description is given of the environmental setting of the area including the vegetation, aquatic resources and wildlife. The effects of the double tracking project on vegetation, aquatic resources, and wildlife are described. Construction of the right type of culvert in summer would eliminate most of the concerns for fish resources in a small stream at Mile 91.2. Concerns for siltation of the Illecillewaet River from the track bed material are minimal. The track is fringed with dense, mixed stands of trees but almost none of the forest cover will be affected by the project. No new access roads will be necessary and there will be little if any noise and dust perceivable by users of the Trans-Canada Highway and there will be no foreseeable traffic delays.

067042
MINNI SJ * **Final report, Paddle River Basin, historical resources impact assessment, appendix C** . IN: Paddle River Dam environmental impact assessment * v2 25p * Alta Environ, Plann Div * 1981-11.

During August 1979 an historical resources impact assessment was conducted in the Paddle River basin near Rochfort Bridge, Alberta. The purpose of the assessment was to determine the impact on historical resources by an Alberta Environment flood control project designed for the Paddle River. The field survey located 14 archaeological sites (12 prehistoric and two historic) and five separate groups of historic structures. The prehistoric sites were very limited in nature and few remains were recovered. These sites were generally located at the upper edges of the river basin. They appeared to have been occupied by small numbers of people who passed by rather than through the river basin. The historic sites and structures were located within the river basin and were all thought to date from the early to middle 20th century. These sites were considered to be associated with farming/ranching activities. The work involved with the proposed flood control program will destroy or seriously disturb four prehistoric sites and all of the historic sites and structures. While it is recognized that none of the located historical resources had much potential in terms of artifact return additional investigations are recommended for two prehistoric archaeological sites (FlPs 4 and 8) and two historic archaeological sites (FlPs 5 and 15) prior to impact by the development. The remaining sites and structures are too limited, disturbed or recent to require further investigation.

062625
NEWFOUNDLAND & LABRADOR HYDRO, ENVIRON SERV DEP * **Cat Arm hydroelectric development: Environmental impact statement** * 263p * Newfoundland & Labrador Hydro, Environ Serv Dep, 5th Floor, Philip Place, St John's, Nfld * 1980-12.

This is a synthesis of component studies done by consultants on the proposed Cat Arm Development located on the raised uplands of the Long Range Mountains in the south eastern quarter of the Great Northern Peninsula, Newfoundland. The report provides an account of the proposed development. It describes the environmental setting (physical, biotic, and human) and discusses the impacts of the project in relation to each. It is felt that construction of the reservoir will result in changed geomorphology and local drainage patterns. Mitigation measures are proposed. Stands of merchantable timber within the future reservoir area are not harvested due to lack of access. Construction of access roads will increase the potential for forest utilization. At present, plankton biomass in the system is low. Fish include brook trout (freshwater and sea run), Atlantic salmon, and American eel; however, populations are modest. Reservoir formation will increase aquatic habitat, possibly resulting in an increase in brook trout numbers. The flow down the Great Cat Arm River will be significantly reduced and will degrade the habitat for the small run of salmon and sea trout at the mouth of the river. Loss of terrestrial habitat through flooding is the most significant impact on wildlife. Approximately 17 mammal species are reported to occur in the study area. The most important game species is moose with one of the highest populations on the island. Aquatic and terrestrial furbearers occur in limited numbers. The impact on moose will result from habitat loss and increased access. Reservoir formation will remove winter range and reduce the total carrying capacity of the area. The human population of the study area and the impact of the project is detailed. Communities closest to the project are: Jackson's Arm, Sop's Arm, and Hampden. Construction activities will require 1300 man years over a 43 month period. A small percentage of the labour force will come from the immediate area. Completion of the access road with a policy to make it available for public use will provide opportunities to utilize the natural resources of the area.

065974
PAMPLIN WL * **Mitigation of fish and wildlife impacts of oil and gas development in Alaska** , IN: Symp on Fish and Wildlife Resources and Economic Development, Edmonton, Alta, April 26-27, 1983 * Alta Soc Prof Biol Symp Ser No 7 * 173-191 * Alta Soc Prof Biol, PO Box 566, Edmonton, Alta T5J 2K8 * (1983).

A general overview is provided of mitigation techniques that have been applied to onshore oil and gas developments (particularly pipelines) in Alaska. An interagency/interdisciplinary organization is

proposed for use during all project phases. Major construction activities and associated surface disturbances are discussed with emphasis on preventing or minimizing long-term adverse impacts to fish and wildlife resources. Restoration efforts stress the reestablishment of native vegetation and rehabilitation of aquatic habitats.

067046
R.C. STUTZ MANAGEMENT CO. LTD. * **Paddle River site 7B environmental impact assessment, vegetation, appendix E** , IN: Paddle River Dam environmental impact assessment * v2 16p * Alta Environ, Plann Div * 1981-11.

This study was undertaken to describe the existing vegetation in the 700m contour upstream of the proposed Paddle River dam and to predict changes and effects on vegetation resulting from the construction and operation of a dam and reservoir at site 7B. Mapping, air photo interpretation and field studies were used to determine the type and extent of vegetation. Evidence was found of slope instability along the Paddle River Valley which can be traced to disturbance of vegetation. Existing vegetation will be removed by construction activities and changes in flood frequency and duration will cause aquatic communities to develop to a greater degree than at present. Recommendations are presented to reduce the impact on vegetation by the proposed dam and reservoir. The removal of all construction materials from the site is necessary. This will cause less surface disturbance and therefore less destruction of vegetation. All surface disturbance should be revegetated according to land use priorities. The revegetation plan should also consider adequate erosion control, development of fertile soils and the establishment of self-maintaining plant communities.

067043
REID, CROWTHER & PARTNERS LTD * **Paddle River Dam, site 7B environmental impact assessment, land use component, appendix B** , IN: Paddle River Dam environmental impact assessment * v2 60p * Alta Environ, Plann Div * 1981-11.

The purpose of this report is to describe the present land use and land capability of that part of the Upper Paddle River in the vicinity of Site 7B, and to discuss potential changes to land use and land capability resulting from the impoundment of the Paddle River by a dam at Site 7B. The perceived impacts of the project on the study are then used to identify procedures which may be implemented to mitigate these potential changes to existing land uses; and monitor any programs associated with the introduction of mitigation measures. The Paddle River Basin is located in central Alberta. The basin drains an area of approximately 2,486.3 sq. km (960 sq. miles), with the Paddle River ultimately flowing into the Pembina River 9.5 km (6 miles) east of Barrhead, or 72 km (45 miles) northwest of Edmonton. For the purposes of this report the study area includes the site of the proposed dam and reservoir and lands which lie adjacent to these proposed developments.

062607
ROBERTS K * **The British Columbia Utilities Commission hearings regarding British Columbia Hydro and Power Authority's proposed Site C hydro-electric dam on the Peace River: the case for public involvement in environmental impact assessment** , IN: Environmental Government Affairs Seminar, Proc, Environmental concerns of the 80's, October 12-15, 1982, Ottawa, Ont * 171-201 * Air Pollut Control Assoc and Fed Assoc Can Environ * 1982-10.

This paper reviews the environmental impact assessment process in British Columbia from the perspective of public interest organization. The analysis focusses on hearings currently being held by the B.C. Utilities Commission to assess a three billion dollar hydro-electric project approximately 4 miles south-west of Fort St. John on the Peace River. A brief overview is presented of the projected and of the evidence presented by B.C. Hydro. The process established by the Utilities Commission to conduct its first major energy project review is discussed. Some of the problems encountered are described with particular emphasis on the environmental impact assessment. A case is made for public involvement in this process. It is concluded that public involvement in consideration of a project, including its Environmental Impact Study, is a cost-effective and necessary part of a decision-making process where the objective is to determine what is in the public interest. Appendices to the paper include the terms of reference for Site C hearing, criteria for cost awards, and an article regarding provincial government blue papers.

062608
ROBINSON RM * **Environmental impact assessment: government decision-making** , IN: Environmental Government Affairs Seminar, Proc, Environmental Concerns of the 80's, October 12-15, 1982, Ottawa, Ont * 122-128 * Air Pollut Control Assoc and Fed Assoc Can Environ * (1982).

This paper desribes the Environmental Assessment and Review Process (EARP) introduced by the federal government in 1973. The process is designed to determine the environmental acceptability of proposals that either require federal money or use federal lands and property. In so doing it helps ensure that environmental matters are given appropriate weight in planning along with economic and technical factors. The process

is not statutory, but was established by a cabinet directive specifically indicating that the public be informed and consulted during the review process, normally through a specially appointed panel. The Federal Environmental Assessment Review Office (FEARO) was established to administer the process. Since the first review was held in 1976 the process has been evolving. The biggest challenge to date has been the review of the proposal to produce oil and gas in the Beaufort Sea and transport these southward by pipeline, ice-breaking tanker or by both means. In its attempt to build a more effective scientific basis for environmental impact assessment FEARO has edited and published a summary of environmental assessment practice in Canada and is preparing a set of guidelines to improve the social impact assessment aspect of environmental reviews.

061890
ROSS WK, NG KS * **Protecting the aquatic environment at a tar sands plant** , IN: Proc 35th Industrial Waste Conf, Lafayette, IN, 13-15 May 1980 * BELL JM * 463-475 * Ann Arbor Sci Publ Inc, PO Box 1425, 230 Collingwood, Ann Arbor, MI 48106 US * 1981.

It is estimated that by 1990, the shortfall in Canadian crude oil supply could be more than 160,000 cu m/day (1 million bbl/day). As the conventional oil reserves continue to decline and the price of crude oil escalates, there will be great pressure and incentives for developing the nonconventional sources of energy supply, mainly oil sands leases and heavy oil reserves. There are three immense deposits of heavy oil estimated at over 10 sup 12 barrels in-place in Northern Alberta. The oil sands exist in layers interspersed with shale rock. A limited portion of the Athabascan deposit, by virtue of its limited overburden thickness, is amenable to surface mining. Currently, there are two oil sands plants (Suncor and Syncrude) operating in this area. The major zone, the Clearwater, which is located about 1500 feet below surface in most areas, has not yet been commercially developed. Based on technology developed from a 11,000 cu m/day (7,000 barrels/day) pilot plant currently operating in the Cold Lake area, Esso Resources plans to recover the bitumen from these oil sands by in situ steam injection. The project will include heavy oil recovery and upgrading failities to produce 22,000 cu m/day (140,000 barrels per day) of synthetic crude suitable for refining by a typical Canadian refinery. The environmental protection measures associated with the operation are described in this chapter.

063770
ROSS WM, MARTS ME * **Agreements and aftermaths: the Columbia, Kootenay, and Skagit, Chapter 7** , IN: Water problems and policies * SEWELL WRD, BARKER ML * Cornett Occas Pap No 1 * 69-77 * Dep Geogr, Univ Victoria, Victoria, BC V8W 2Y2 * 1980.

This paper illustrates the value of hindsight reviews in assessing environmental programs and suggests a classification scheme for such evaluations. It also evaluates the continuing impact of the Columbia, Kootenay, and Skagit River projects on water resource management in the region. The evolution of electrical generation in the region is examined in order to see how the change in stage of development will impact upon power planners. This review of development of energy in Canada and the Pacific Northwest of the United States suggests that British Columbia has greater potential for future generation of hydro-electric power. Given the United States growth in electricity demand and the potential withdrawal of Canadian-owned power, the value of small-scale projects is now very great. However, there are potential environmental conflicts between Canada and the United States over flooding. These projects will do little to enhance the ability of the region to meet normal growth in firm electrical power needs and would not help the United States significantly should Canada withdraw power in the second thirty years of the Columbia River Treaty. The problems of increasing prices, potential flooding of land in Canada, withdrawal of power under terms of the Columbia River Treaty, and a host of other energy related matters between Canada and the United States portend conflict over energy. To reduce this potential for conflict, policy makers in both countries must seek "midsight reviews" of power projects to assess changes in their energy needs and sources.

062624
SHAWMONT NEWFOUNDLAND LTD * **Cat arm access roads, Environmental assessment** * SMR-3-80 * vp * Shawmont Newfoundland Ltd, Virginia Park Plaza, Newfoundland Drive, St John's, Nfld * 1980-02.

This report reviews the available biophysical information pertaining to the area along the coast of the Great Northern Peninsula, Newfoundland, between Jackson's Arm, and the site of the proposed Cat Arm Hydroelectric Development. It presents the results of field work conducted to assist in the selection of routes for permanent and temporary access roads and a transmission line. It examines three potential routes. Field work involves both aquatic and terrestrial biology and hydrology. Aquatic work describes fish species and population densities in streams, rivers, and lakes to be crossed by, or which will be adjacent to, the proposed road. The main species is brook trout. Fish productivity is low except for Coney Arm River which has a substantial run of Atlantic salmon. All streams are generally low in nutrients. The report describes the environmental setting and wildlife

distribution. The most significant game species is moose. The report discusses techniques designed to maintain vegetation, eliminate silt from water courses, and dispose of debris. It also reviews various techniques for crossing streams, such as, bridge crossings, culverts, or fordings. The preferred route limits interaction with caribou and Atlantic salmon; however, it does interfere with existing moose habitat. The major mitigative measure suggested involves limiting use of the permanent access road. An environmental appraisal of the alternative permanent access roads is included. The report describes the routing for the temporary access roads and recommends mitigative measures which will limit their impact. The various borrow sites are described. Those which are located close to sensitive areas are removed from further consideration. Mitigative measures include: stabilizing of slopes, and reseeding. The report describes the transmission right of way which essentially parallels the permanent access road from Jackson's Arm to the power house at Devil Cove. Impacts on moose populations, raptors, and the possible effects of clearing techniques are discussed. The report also deals with optimun culvert design for stream crossing, the suggested construction schedule for the access road, wood volumes, and road construction techniques.

065865
STRONG HALL & ASSOCIATES, CALGARY, ALTA * **Paddle River dam project, environmental impact assessment, community impact component, appendix J** , IN: Paddle River Dam, environmental impact assessment * v3 36p * Alta Environ, Plann Div * 1981-11.

This community impact study is one component of the overall Environmental Impact Assessment of the Paddle River dam project. Because many of the key decisions in project planning have already been made, the utility of this study is in summarizing community perceptions of potential project impacts, and in making specific recommendations that would help to make the project as beneficial as possible to the affected community. The study regions spans two counties northwest of Edmonton and includes four small communities and the surrounding farm area along the Paddle River. Flooding of the Paddle River has been perceived as a problem since the turn of the century, when the first homesteaders arrived to begin farming in the area. Attitudes of farmers downstream of the proposed damsite are very positive toward the project. They feel that the dam and reservoir will bring great flood-control benefits. Residents in the immediate vicinity of the damsite have mixed views. Some strongly oppose the dam for economic, environmental, and social reasons. Other feels that the potential benefits of the dam outweigh the potential problems, particularly if the reservoir can be used for municipal water supply and recreational purposes. The pre-construction stage of the project has already benefited downstream people. Farmers are very pleased with the results of channelization and dyking, and local contractors have benefited from earthwork contracts. Upstream people have not yet benefited in any significant way from the project. In fact, some farmers who will lose land to the reservoir have experienced considerable inconvenience, and the community at large has suffered from divisiveness as a result of controversy over the project. During the construction stage, the community could benefit considerably through local employment and local contracts. There will be no significant increase in demand for community infrastructure and services, but it is likely that the project will give a general boost to the local economy. Construction activities will cause some local inconvenience due to dust, noise, and road wear. Post-construction impacts are somewhat uncertain, and depend largely on the success of efforts to beautify the reservoir area and to develop it for alternate uses, as well as the effectiveness of the dam as a flood-control mechanism. This report concludes with eighteen recommendations to the Government of Alberta for mitigating potential problems and enhancing potential benefits of the Paddle River dam project, to make its impact on the community as positive as possible.

12. RESEARCH - RECHERCHE

066113
DAVAR KS * **Hydrotechnical research needs in Canada** , IN: 5th Canadian Hydrotechnical Conf, Proc, May 26 and 27, 1981, Fredericton, NB * v2 977-989 * Can Soc Civ Eng * (1981).

Research on solutions to short-term pressing problems and strategic long-term developments are essential characteristics of a futuristic technology, such as hydrotechnical engineering. The hydrotechnical research needs presented in this report reflect the perspectives of the Research Committee, based on the broad range of suggestions received from the membership; it undoubtedly reflects the background and perferences of the members of the Research Committee. In this case the guiding principle has been to identify some areas of high priority and engage in productive work on these, based on the available dedication, expertise, and resources of willing workers in the Research Committee and membership at large. The current role and proposed activities of the Research Committee of the Hydrotechnical Division are also briefly presented. Research needs, priorities and activities constantly need updating, stimulation and revitalization. Members of

tne Hydrotechnical Division are invited to work with the Research Committee in meeting these challenges of the future.

063455
INLAND WATERS DIR, ENVIRON CAN * **Water resources research support program 1982-1983** * 12p * Environ Can, Ottawa, Ont * 1983.

A listing of the thirteen universities across Canada which would share $250,000 for water-related environmental research at the regional and national level during 1982-83, is presented The Water Resources Research Support Program is intended to provide for innovative research relevant to Environment Canada's concerns and responsibilities for water resources research in the natural and social sciences with emphasis on water management issues. For each research agreement, information provided includes author's name, university affiliation, title of project, liaison officer's name and address, descriptions of project, and value of agreement. A description of the regulations governing the use of Inland Waters Directorate Science subvention funds, is also provided.

062301
ONT MINIST ENVIRON * **Inventory of research projects 1979-80** * vp * Ont Minist Environ * nd.

This inventory consists of profiles of the individual research projects conducted by each Branch of the Ontario Ministry of the Environment in the 1979/80 fiscal year. It includes in-house activity as well as research generated by grants to universities, contract research and project supported by joint funding with others. The projects are grouped under their funding branches, boards, or committees. The profile supplies the following information: branch, project title, key words, principal investigator, liaison officer, supervisor or senior ministry official, research category, objective, description, duration, budget, source of funds, reporting procedure, and participation by other ministries.

13. MISCELLANEOUS - DIVERS

064788
ALBERTA ENVIRON * **Environment views** * 6(5) 1-40 * Alberta Environ, 12th floor, Oxbridge Place, 9820-106 St, Edmonton, Alta T5K 2J6 * 1983.

Environment Views is published bi-monthly by Alberta Environment. Each issue deals with specific topics from various viewpoints with the aim of increasing awareness of environmental issues among Albertans. Environment Views is directed by an independent board with representation from environmental groups, government, and industry.

066075
BRAY DI, DAVAR KS (CHAIRMEN) * **5th Canadian hydrotechnical conference, Proceedings, May 26 and 27, 1981, Fredericton, N.B.** * 2v * Can Soc Civ Eng * (1981).

The proceedings of the 5th Canadian Hydrotechnical Conference provides a forum for the presentation of all aspects of hydrotechnical engineering. This broad topic includes: hydroelectric engineering; hydraulics and hydraulic structures; river, lake, coastal and ocean engineering; irrigation and drainage; water resources engineering, ice mechanics and ice engineering; and civil engineering aspects of fluid mechanics.

066023
ENVIRON CAN, ATL REG * **Some environmentally-oriented theses from Atlantic universities** * 71p * Environ Can, Atl Reg, Halifax NS * 1982-08.

A significant amount of time and effort is being expended in the Atlantic Region on the study of environmental problems. While various provincial and federal government departments have data and interpretive material in their files, another source of information is often forgotten. The universities in the Atlantic Provinces are repositories of historical and other environmental information. The latter can be found in Honours B.Sc. theses, M.Sc. theses and Ph.D. disserations. Environment Canada considers that this information might be of value to government agencies, consultants or other universities which are involved in the preparation of impact assessment statements and in the development of data collection programs. The list presented is not comprehensive, but it does present a compilation of many of the available ecological and physiological theses and dissertations.

064867
ENVIRON CAN * **Environment update (periodical)** * 4(3) 14p * Environ Update, Environ Can, Ottawa, Ont K1A 0H3 * 1983-09.

Environment Update is a bi-monthly publication of the Information Directorate of Environment Canada. The aim of this journal is to inform interested people about the programs and activities of the department and to create and maintain links between the department and citizens or colleagues outside the government. Each publication features a specific topic and includes articles on other topics from across Canada which reflect the full spectrum of the services of Environment Canada.

064123
LEE DW, NEVILLE MJ, KERR GA * **Persons involved in environmental research in Alberta** * 185p * Alta Environ Cent, Vegreville, Alta T0B 4L0 * 1983-03.

This publication is a list of names of persons, with addresses and interests, involved in environmental research in Alberta. These names can also be accessed by means of the subject index. Environmental research has been defined as the scientific activity undertaken with the primary aim of maintaining, restoring or improving the environment, or for predicting changes in the environment.

063244
MANITOBA DEP NAT RESOUR, LIBR SERV * **Annotated bibliography of the renewable resource publications of the Manitoba Department of Natural Resources, 1981** * Manuscr Rep 82-1 * 39p * Manitoba Dep Nat Resour, Libr Serv, Winnipeg, Man * 1982.

74 publications in the areas of fisheries, forests, parks, water resources and wildlife management are listed and indexed. Abstracts are provided for most of the publications.

067190
SCOTT MD (ED) * **Third biennial plains aquatic research conference, proceedings, August 24 and 25, 1983, Montana State University, Bozeman, Montana** * Can Plains Proc 11 * 243p * Inst Nat Resour, Dep Earth Sci, Montana State Univ and Can Plains Res Cent, Univ Regina * 1983.

Two major types of material have been featured - technical papers and a Special Symposium. The technical papers in various water-related disciplines provide for communication among research specialists and people who work with water resources in an applied sense. These papers have been grouped into 4 sessions: biological sciences; hydrology; reclamation of water resources; and water resource management and policy. The Special Symposium was designed to generate a "state-of-the-art" discussion on one particular water management issue in the plains environment. The theme this year was "International Management of Water Resources". This publication provides an overview, by representatives of provincial and state governments, on the current international controversies and cooperation that have risen out of attempts to manage waters that cross the Canada - U.S. border.

065744
TOWNSEND RD (ED) * **Canadian Society for Civil Engineering, 6th Canadian Hydrotechnical Conference, Proceedings, June 2 & 3, 1983, Ottawa, Ont** * 2v * Can Soc Civ Eng * (1983).

The keynote address centred on engineering research needs development with the 10 sessions in Volume 1 being statistical hydrology, hydraulic structures, open channel hydraulics, flood studies, environmental studies, physical models, sediment transportation, unsteady flows, water resources engineering, and sea ice. The 8 sessions included in Volume 2 are concerned with pipelines, local scour, sedimentation, energey dissipators, stormwater management, coastal processes, ice mechanics, and case studies. The invited sessions describe stormwater management in the Canadian environment, the Canadian coastal sediment study, Canada's Inland Waters Directorate, and the importance of geomorphology in hydraulic engineering. Abstracts are provided in English and French for all 57 English papers and 4 French papers.

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